AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 15, NO. 29. WEEKLY. | NEW YORK, THURSDAY, JULY 21, 1892. | $3.00 per Annum. SINGLE COPIES 6 CENTS

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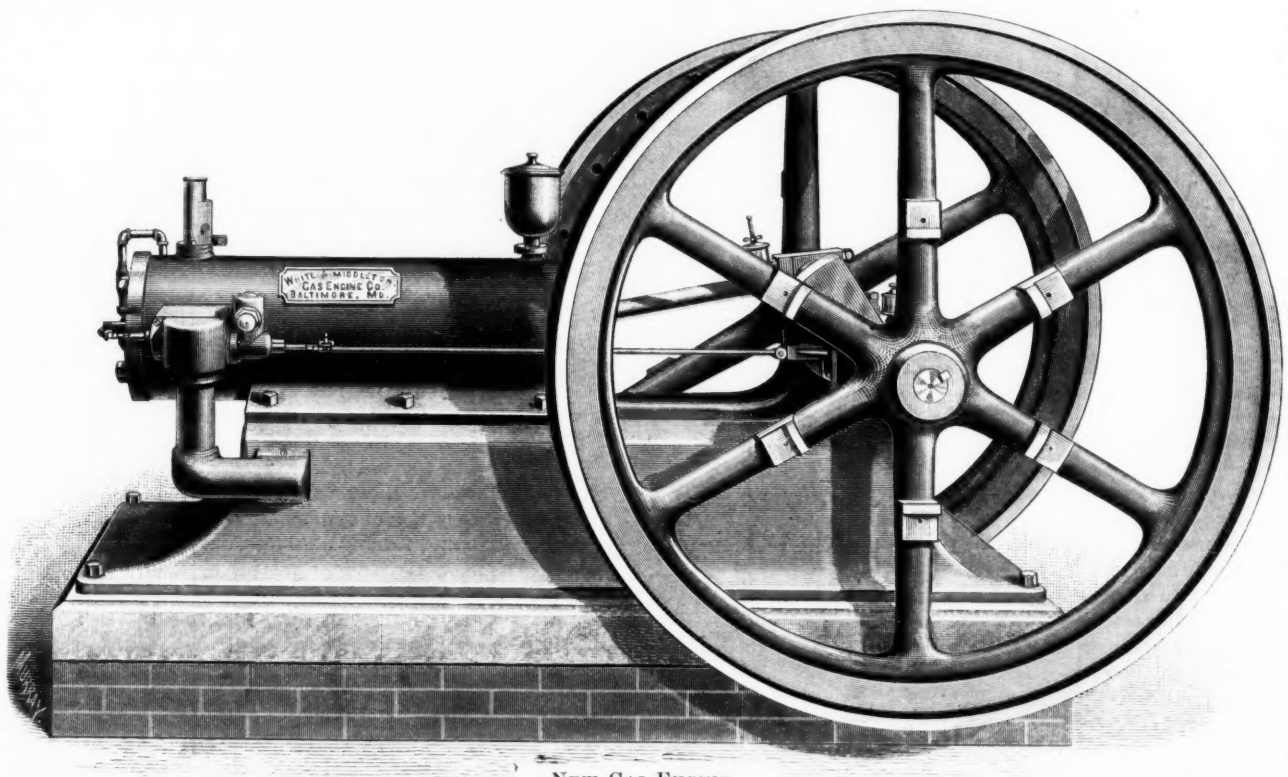
New Gas Engine.

The gas engine of which we give an illustration is the invention of Charles White and A. R. Middleton. A number are now in use and have given excellent results; they run very smoothly and with great economy. They may be classed with the compression gas engines. The piston is of the trunk pattern, connected to the crank direct by the wrist-pin and connecting rod, without crosshead. The cycle or method of work is the same as that of several familiar gas engines, namely: The gas and air which is mixed in the chamber *a* is drawn through the valve opening *b* into the cylinder by the outstroke of the piston, is compressed in about the proportion of four to one by the following instroke, and is ignited on the center by uncovering the inlet to an incandescent closed tube, the charge being exploded and the impulse received on the outstroke. The exhaust port *f* is uncovered by the piston at its extreme outstroke, and the products of combustion (or upwards of three-fourths of the same) are discharged. The balance of the burnt charge remaining in the cylinder at atmospheric pressure (except that filling the explosion chamber) is expelled through the valves *e* and *d* by the following instroke, and a fresh charge of mixture taken in by the next outstroke.



NEW GAS ENGINE.

The poppet valve *e* is operated by the lever *g* working on the fulcrum *h*. This lever receives its motion from the rod *i* which is actuated by the slide *k*. An eccentric is placed on the crank-shaft at *l*. A governor is attached to the crank web *m*. Its centrifugal action causes a connection to be made between the eccentric and slide *k*, thereby operating the poppet valve *e*, and also the gas supply valve, but at such times only, when an explosive mixture is required for the amount of work the engine has to do. When the engine runs at its full capacity these valves open at every other stroke; when less work is required they do not open as often. The valve *c* always opens slightly in advance of the gas supply valve.

The construction of the governor (not shown) is novel, neat, and very effective, giving a very close regulation. The incandescent closed tube igniter works with positive and prompt ignition without the loss of a single charge, even under a speed of 280 revolutions per minute. The tube is a ¼-inch gas pipe, 9 inches long, closed at the top and screwed into the cylinder, being kept red hot by a Bunsen burner surrounding it.

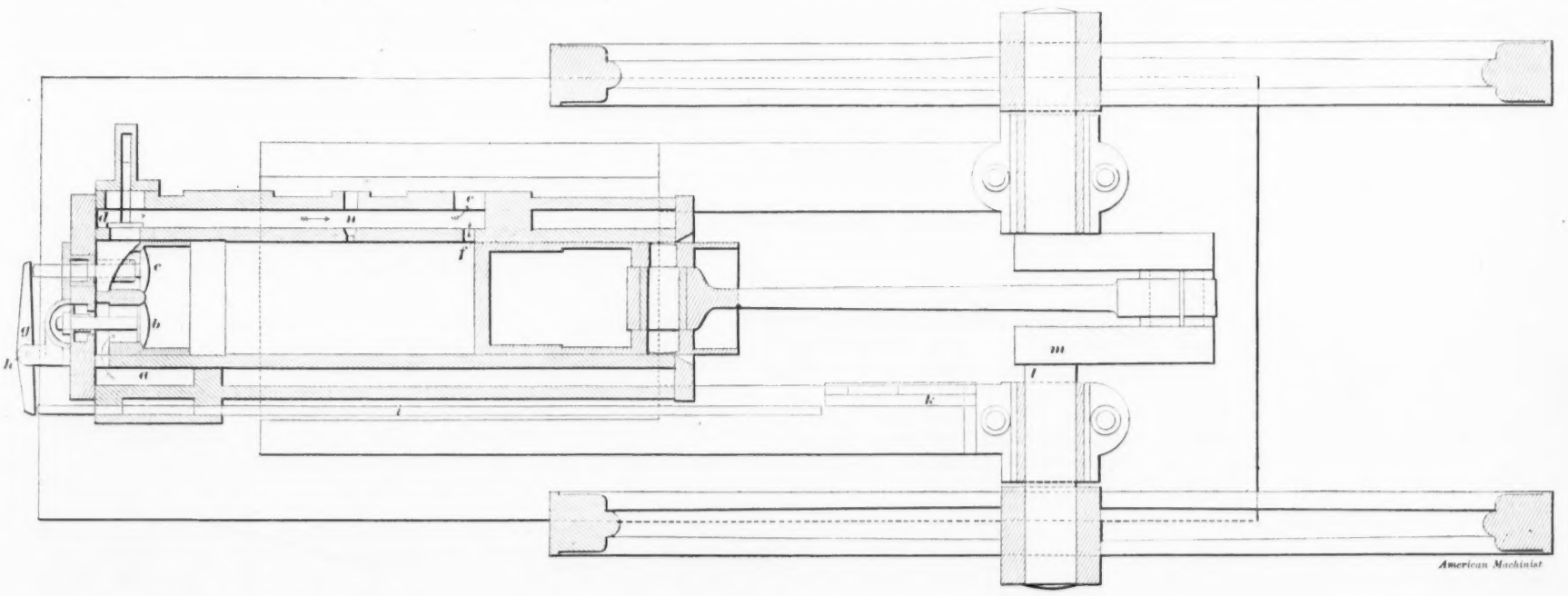
The charge of mixture under heavy compression rushes up into this incandescent pipe and is ignited. A small valve covers the opening *n*. It is opened and closed by hand for the purpose of relieving the cylinder of air pressure when the engine is to be started.

At the American Institute Fair, an engine of this kind, with a cylinder 6 inches diameter and 12 inches stroke, rated nominally at 8 I. H. P., was exhibited and tested. The following extracts from the judges' report give the result of the tests.

"This engine since the opening of the exhibition has been running a 'C. & C.' 7 H. P., or 75 light dynamo belted direct from the fly-wheel of the engine, running usually at 212 revolutions, and supplying 61 incandescent lights, and running also a 12-inch fan at 1,400 revolutions through a small electric motor.

"We tested this engine by request of the agents, Messrs. Jeffers & Kumberger (158 W. Broadway, N. Y.), under brake power, with the following results: Duration of test, 10 minutes. Average speed, 215 revolutions per minute. Actual brake horse-power developed, 5.98. Consumption of gas during 10 minutes, 19 cubic feet. Consumption of gas per brake horse-power, 19.06 cubic feet. In running without a load the engine required at nominal speed a charge of mixture (as shown by the operation of the governor) once in 10 revolutions, showing the friction to be 20 per cent. This, if the same percentage held good under a load, would give the engine during the test, as estimated, 7½ indicated horse-power, which would show a consumption of 15.2 cubic feet of gas for each indicated horse-power, which is an economy, so far as we know, never before reached in any gas engine.

"The brake lever used in this test was the ordinary wood clamp (balanced) 4 feet 3½ inches from the center of engine shaft to the point of contact by a steel pin on the scale, which was an ordinary Fairbanks grocers' platform scale. The scale showed 34 pounds, balanced continuously during the test, and kept balanced by tightening or loosening the brake. The speed varied from



202 to 225 revolutions, but averaged 215. The gas meter used was a 45-light meter, made by Harris, Griffin & Co., Philadelphia, Pa., and was guaranteed as correct by the N. Y. Mutual Gas Light Co.

"We are thus explicit in giving the details, as the results show a hitherto unattained economy in gas engines. The heat generated on the pulley by the brake prevented our continuing the test for a longer time. It is to be regretted that want of time and proper appliances prevented our making a test with the indicator, which would be more satisfactory, and by which, in connection with the brake, the real economy of the engine could be more clearly shown."

At a later date another test of a larger engine was made at the American Institute Fair. Cylinder, 6½ inches diameter, 15 inches stroke. The following table gives the result:

Trial	A	B	C	D
Duration	3 Hours	½ Hour	¼ Hour	¼ Hour
Weight raised in pounds	115½	54	.....	133¾
Revolutions per minute	195	201	206	193
Brake horse-power	8 21	3.96	.....	9.42
Gas per brake H. P. per hour	16.33	18 28	.....	16.02
Total gas used	402.3	36.2	6.3	76 3

The simplicity of construction, durability, economy, steady and noiseless running, and ease of starting these engines, will undoubtedly increase their popularity. They are manufactured by the White & Middleton Gas Engine Co., corner East Falls avenue and Pratt street, Baltimore, Md.

Practical Details of Blacksmithing.

By B. F. SPALDING.

FORGING MACHINES—PRESSURE AND PERCUSSION—PUNCH PRESSES FOR FORGING—LONG OR SHORT STROKE—HORIZONTAL BENDING MACHINE—EASE OF ADJUSTMENT—RIGIDITY — BENDING BY STRAIGHT THRUST—STRAINING STOCK—BENDING CAR TRUCK FRAMES SIDEWISE AND EDGEWISE—FORMING BOX CAR STEPS—ADDITION OF MOVABLE PARTS—VISE—SWINGING JAWS—3-THROW CRANK—MULTIPLE PUNCH.

Forging by pressure is done by machines which have control of the power which does the work during the whole time of its performance, while forging by percussion is done by machines which give the hammer its impetus, and leave it free to execute its work by the force stored in it. Some machines, as some styles of trip-hammers, punch presses generally, bolt headers, bending machines, and many special machines, deliver a blow from the force stored in the hammer head, or a balance wheel, and receive additional assistance from the first motor during the execution of the work, and such machines may be considered as combining the pressure and percussive principles

In a purely percussive machine the amount of resistance in the work does not much affect the driving power, as, for instance, it will not affect the power much differently whether the piece between the dies of a drop-hammer offers only so much resistance as to let them come together, or whether it is so great as to keep them apart an inch, except the rebound, for when the weight comes in contact with the work it is as free from its connection with the driving power as though it never had, and never would have, any such connection. The rebound of the hammer does not assist in striking the following blow, but is of great assistance to the power in taking the hammer up. More than one would think could be gained from the elasticity of hot iron. At the first blow struck on an almost melted piece, where there is absolutely no rebound, the drop staggers slowly up at a dead lift, while from some succeeding blows, while yet the fin and piece are still red, it goes up as free as a rubber ball.

In machines like punch presses, where the balance wheel has stored power (momentum) enough, it performs its ordinary task without perceptible check, but when the resistance is excessive it delivers the whole force of its stored power as a blow, and the blow being insufficient to effect its purpose, strikes back, and this rebound affects the wheel, not to assist it, but to make it demand assistance from the driver. It is at this moment that twice the whole force of the machine is being spent in direct stress upon the machine itself—once in compression, giving a crushing stress upon the pitman or its equivalent, and once in the throat, in resisting this force which tends to tear it open, and often has the disadvantage of leverage against it.

Punch presses, adapted for the purpose, have been used many years for the purposes of bending iron, welding rings, and forging such work in dies as is generally known as "drop forging." For convenience it is necessary that the stroke should be longer than that required for punching. If the stroke for punching iron ¾" thick is 1½", it is

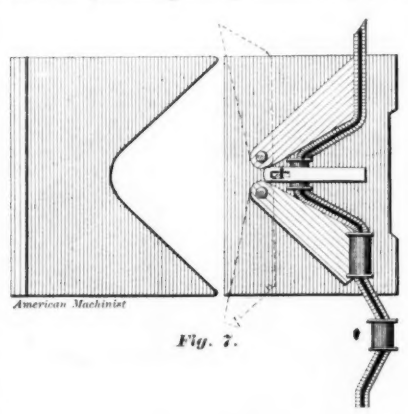


Fig. 7.

Fig. 4.

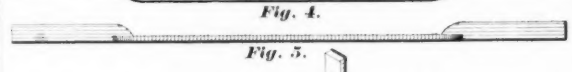


Fig. 5.

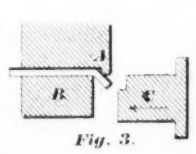


Fig. 3.

Fig. 2.

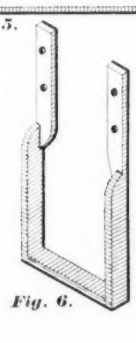


Fig. 6.

Fig. 1.

ordinarily long enough to afford all the roomage needed, but in bending iron it is more convenient to have a stroke which is long enough, so that when it is drawn back there will be plenty of room to put the piece which is to be bent into it, without having to stop to make rudimentary crooks before it can be inserted between the dies. If it is to be bent with an offset of three inches it is well to have a stroke of four inches, for in working hot iron rapidly it is indispensable that there shall be as little as possible in the way to interfere with quick handling.

There seems to be something of notion in the popular idea of the difference in power between a punch of short stroke and one of long stroke, and just what the mixture of notion and science may be is only to be determined by the criterion upon which science is founded. The actual test must be applied, for there are so many conditions in the problem that theory cannot be furnished with sufficient variety and accuracy of data to decide. Considered as a lever, it may be said that if half the throw of the crank or eccentric is taken as the short arm, and the radius of the balance wheel as the long arm, the decision must be that the shorter the throw the greater the power. If the radius remains the same, say 30", and half the throw in one case is 1", and in another 5", the power of the first would be six times that of the second. But the positions of the lines of forces when the punch is brought to its duty and is entering, going through and leaving the iron, are not coincident with those of a lever. In the two cases instanced, if a bar half an inch thick is punched, the punch just going through, the travel of any point on the balance wheel, from the point where the punch strikes the work until it clears itself again, will be for the short throw 121°, but in the long throw only 52°; that is, the travel of the balance wheel for the short throw crank to punch a bar of half-inch iron is only 2⅓ times the distance which is required by the throw of the longer crank, and this does not at all agree with the conclusion that it is six times as powerful. Furthermore, as the travel of the balance wheel in the first case is through 2⅓ times as many degrees as in the other case, it is plain that it must have been 2⅓ times as long in pushing the punch through, and therefore the advantage of the velocity at the objective point is greatly in favor of the long stroke. Suppose this velocity to be just great enough to drive a tallow candle through a board as though it was fired from a gun, what effect would the candle have on the board if it was only going at ⅓ of the requisite speed? The amount of bearing this has upon the subject is proportionate to the amount of work, which depends relatively upon the stored energy, or upon constant accession of power from the motor. The greater the momentum, the greater the gain for the long throw. The principles of the toggle joint are also involved in this subject, as well as other conditions and principles, which complicate its theoretical consideration.

It is safe enough to accept the statement of a prominent manufacturer, that the convenience of using a long stroke will, in a great many instances, compensate for any loss of power which may result from its use.

For many purposes the horizontal bending machines, which have come so rapidly into use during the last ten years, possess obvious advantages of position over punch presses which have been adapted to be worked as vertical bending machines. They have sometimes been termed forging machines, but their use is more general in producing alterations in the shape rather than in the dimensions of stock. In these machines the ram head has a reciprocating rectilinear or straight forward and back motion, and the formers, or dies, if properly devised, lie in many instances in such a position that it is as easy to

place the work in them as it would be to lay it upon a table; they open in plain sight of the workman, and the stroke is long enough to permit perfect freedom of action. The movable head travels a certain definite distance every time, and adjusting screws enable the stationary die to be readily moved up to as nice an adjustment as may be required. While in punch presses the adjustments between the dies—some of them very ingenious—are generally connected with the moving parts, it is found in the use of these bending machines to be a great convenience to be able to adjust the stationary die while the machine is in motion. Rigid as the machine appears to be, it constantly gives evidence that absolute rigidity is not to be easily obtained. Even when it appears that the dies are set up as tight as they will bear, it is often found when they are put to work that the work requires more compression. As the machine becomes heated in working it is subject to change of tension which often calls for readjustment, and it is convenient to do this without stopping it.

More different kinds of bends may be made on this machine by using it in the simplest manner, taking advantage only of the direct thrust, than at first thought would seem possible—not that the difficulty would appear to be in the power of the machine to press the stock into these shapes, but in the capacity of the stock to be cramped and pulled upon and forced into such shapes, without being torn apart. Fig. 1 shows a piece which was bent by the direct thrust out of half inch round iron at two strokes, the first stroke making all six of the bends in a rudimentary form at the rate of nine per minute, and the second stroke bringing them all up tight at the same rate. One would think that no kind of stock would pull around through the cramped places *B* and *C*, in order to get the full square bends at *A*; but this was accomplished by leaving all the rudimentary bends rounding, and of sufficient length so that the last stroke had rather to compress the stock thus furnished than to pull in more.

In the piece shown by Fig. 2, which is made at one stroke at the rate of 18 per minute, the stock for the middle bends has to be pulled in through the cramping which is being given meanwhile by the forming of the outer crooks at the same time, or it must be got by the straining of the stock, yet such work do these machines successfully perform on the lowest grade of wrought-iron.

Some of these machines are made of sufficient capacity to bend the bars which form the frames of freight car trucks. These pieces have four bends, flatwise of the stock, to an angle of 145° in bars of iron 6½ feet long and 4"x1¼" in size, which are given at one stroke.

Although the forward motion of the head is in only one direction, yet this is utilized by peculiar construction of the dies to give compression up and down, so that a piece can be bent sidewise and edgewise at the same time. The principle is this: If a piece of straight iron be laid at the foot of an inclined plane in the center of the fixed die, and the moving die in its progress pushes the iron upon the inclined plane in the center, while at the same time it holds down the ends, preventing them from rising, the center of the piece will be deflected sidewise an amount equal to the height of the incline, while edgewise it will have acquired whatever shape the formers have been made to give it. The stress in this case tends to raise the moving die from the stationary die which it slides over, and is equal to the force required to make the sidewise bend. As the moving die is firmly attached to the head, this stress is generally supported by the arrangements which are made to hold the head down to the machine.

When the shape of the piece to be bent makes it necessary that the die shall project so far beyond the bearings of the moving head as to bring excessive stress upon them by means of the leverage, the dies should be so designed as to afford, in themselves, sufficient resistance to the pressure which tends to force them apart.

Pieces which, like the lower step on a box-car - or like hangers for beams—which require a change to be made in the position of the flat sides equivalent to a half twist, may be made on this machine with three strokes at one heat, at the rate of three in a minute. The first stroke gives the two bends where the change is to take place, as in Fig. 4. The second makes the two bends across the dotted lines of Fig. 4, and thus changes the position of the flat sides, as shown in Fig. 5. The third stroke makes the right-angle bends flatwise to form the finished step, Fig. 6. In making jobs of this kind each stroke is to be considered as a complete operation, and the perfection of the finished piece depends upon the perfection with which each operation is performed. No succeeding operation rectifies the errors of the one preceding it.

The use of a vise on the stationary bed, whether operated by hand or automatically, enables the machine to be used as a heading or upsetting machine. It may thus be utilized as a bolt header, and the arrangements for receiving the thrust being easily made, this is one of its common adaptations.

A further advance in the use of the bending machine is in the addition of other moving parts actuated either by the moving head or worked independently by hand. An illustration of this may be seen in bending stock to a right angle without leaving a deficiency on the outer corner. This is done at one stroke by having a vise on the stationary bed which closes and holds its grip as the moving head comes forward, and by making the closing of the vise do a part of the bending which, without this moving addition, would require another stroke. A sectional top view is shown in Fig. 3 of the vise jaws when they have closed up on the stock, and in so

doing have bent it by means of the lip on *A* into the shape which is shown, with a part bent off at an angle of about 45°. This part may be a third longer than it is to be after the die *C*, which is attached to the moving head, has pressed it into place, as shown by the dotted lines. As the head moves forward in the direction of the arrow the end of the bent part is caught by the offset in the die, which, when the die has reached the end of the stroke and bent the part to a right angle, has constrained it to occupy a space only two-thirds of its length; the extra third is upset, and the surplus stock thus driven back naturally fills the deficient outer corner. If a closed die is used on round stock some fin is thrown out, which is removed either by the trimming press or by grinding.

As an illustration of another adaptation of additional moving parts to the machine, and the method of using them, a part of a 3 throw tedder crank is shown, with the top view of the dies for bending it, in Fig. 7. This crank is made of steel triangular in cross-section, and has spools of malleable iron set on it for the circular bearings and shoulders. The cranks revolve upon these bearings; the shape of the cross-section makes it easy to couple as many of them together in line as are needed, and the coupling also forms a journal. The method of bending them is to heat the stock in the center of the bar long enough to form the four bends constituting the center crank; then slip on the center spool and place in the machine, gauging the proper length; fasten by driving the key down through the slot *A* and start the machine. The head moves up, and as the moving die strikes upon the swinging dies, they close upon the stock and force it to assume the desired shape. The center crank is now finished, and the stock for the end cranks is straight. The stock is heated to make one of the end cranks, and when hot the spool for the bearing between the cranks is slipped on loose, and the spool for the center of the end crank is put on and gauged to the proper distance and fastened there; then it is put into the machine, the key driven, and the machine started, and as the swinging jaw on that side comes around, the loose spool is adroitly placed by the operator where it will be caught by the nick in the die which draws it to its proper position as the crank is bent. The same proceedings on the other end complete the three throws of the crank, which, it is almost needless to remark, have been so placed in the machine that when they are bent they stand at the proper angles to each other.

As the moving head is capable of close adjustment, the machine is sometimes used as a multiple punch press, and if proper care is taken to prevent the ways from becoming worn and mutilated, it is well adapted for labor saving in doing this class of work, punching a number of holes at the same time of whatever various sizes and in whatever relative positions may be required, doing, at one handling of any piece within its capacity, nearly as many times the amount of work which a single punch can do as there are holes to punch. It affords excellent facilities for handling work in it expeditiously.

An Improved Sectional Swinging Cupola Furnace.

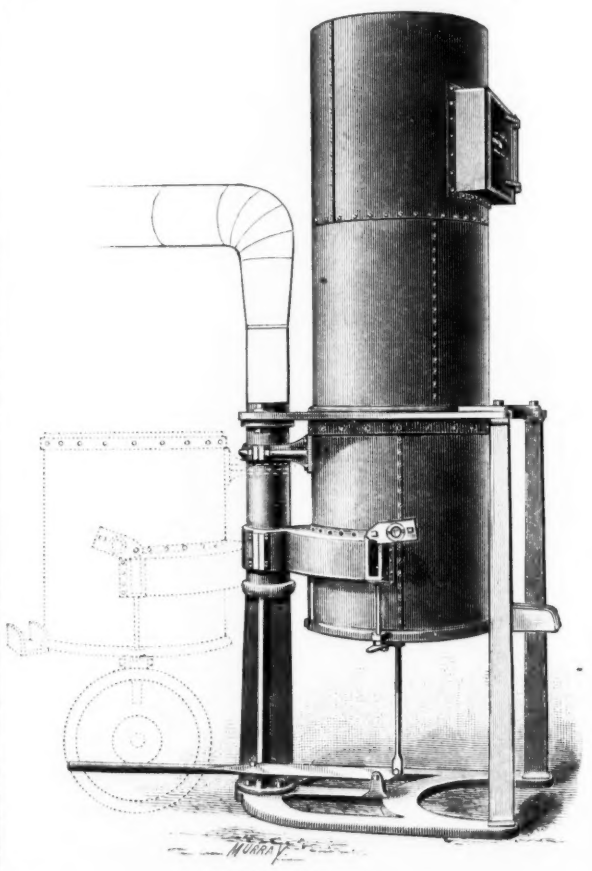
Foundrymen will be interested in the new cupola which we illustrate herewith, the design being especially to facilitate the operation of a cupola by providing for its more convenient cleaning and re-lining.

To this end the lower part of the cupola is hinged upon the tubular column at the rear, as shown, so that it may be readily swung around to the back, and the bottom dropped, as shown by the dotted lines, in which position it is obvious that "picking" or re-lining may be done with the greatest possible facility. It is claimed also that the bottom of sand or clay can be more securely placed in this than in the ordinary cupola, and that after this is done the kindling and first charge of coke are put in place, the top of the section daubed with clay to make a tight joint, swung into position, raised to its place, and supported by the jack shown below. When thus raised, an opening in the column at the rear comes fair with a corresponding opening in the belt ring, and thus the blast is introduced from the pipe shown in outline above. The spout is also hinged to the lower section, so that it clears the front columns as it swings around.

This furnace is also well adapted to melting brass in crucibles, dispensing with the ordinary brass furnace. In this operation the crucibles are put in place while the section is swung out, and are removed in the same manner after melting.

The economy and melting qualities of the cupola have been well considered, and are found to be entirely satisfactory when compared with others, while the cost of attend ance is much reduced.

These furnaces are made in sizes from 18" to 32", and are adapted for use in either commercial or trade school foundries. The manufacturers are the Long & Jervis Foundry and Machine Co., Decatur, Ala.



CUPOLA FURNACE.

Notes on a Problem in Water Power.

BY JOHN RICHARDS.*

In presenting this paper the author introduced the subject by a few remarks, in which he said he had not at first intended it to be presented as a formal paper, but he thought the subject one worthy of discussion, and hoped what he had to say would bring about such discussion. He thought it strange the subject of impact water wheels had not received more attention. What had been done in the way of development of such wheels had been done experimentally. Many wheels had been sent to California which would not give more than 30 per cent. efficiency, and many more of them not over 50 per cent. His paper, as presented by himself, was as follows:

The present paper is to be a non-scientific one, and in other respects is not to be classed among the contributions such as are commonly presented before this society. Neither are its objects the same. The purpose is to present some thoughts upon a very important subject, with a view to calling out further and more able discussion. There being nothing exact or determinate to deal with, there will be neither figures nor quantities included, so that no severe mental strain need be apprehended in following the remarks.

The subject is water motors, or, as we commonly say, water wheels, for utilizing the action of gravity on water, and an inquiry into the probable conditions, inferences, or deductions which have led up to and established modern practice as it now exists in this country.

Water wheels, as we have to deal with them, may be classed as gravity wheels, including (1) overshot breast wheels and perhaps the Poncelet types; (2) pressure wheels, including what we call inclosed turbines and reaction wheels; (3) impulse wheels, driven by spouting water.

The classification thus assumed is, for short, gravity, pressure, and impulse wheels. These may be said to cover the various types in common use.

In modern practice the class called pressure turbine wheels constitute perhaps four-fifths of the whole. These can be divided into three general types, namely: The Fourneyron, or outward radial discharge; the Jonval, or downward discharge parallel to the axis of rotation; and the American, or inward flow wheels. These have come into general use all over the world, and have a literature of surprising completeness. They are by common consent regarded as the most efficient, and, indeed, until recently, have been the only wheels which were considered in connection with an efficiency beyond 60 per cent.

The question to be presented, and the main point in this communication, is, what has produced this particular form of evolution in water wheel practice? and why has pressure instead of impulse been the principle, or mode of operation, followed in all countries?

Before attempting any answer to this inquiry, it will be well to further examine or explain, in as simple a manner as possible the nature of the class called pressure turbine wheels.

A column of water resting upon the vanes of a turbine wheel, which are free on their reverse side, and meet no resistance there, represents complete efficiency less machine friction; and the science of turbines, to so call it, is directed to removing the impeding water and its resistance on the reverse side of the vanes, that is, on the discharge side, after the function of pressure has ceased or has been utilized. It is common to divide the effect of the water, or its functions, in this class of wheels, into gravity, impulse, and reaction, but there is no need of such assumption or introducing the complex nature of these forces thus combined, because the whole is explainable as simple pressure, and all observed phenomena point to this as the "mode of action" in pressure turbines.

I am in this assumption no doubt transgressing upon what are called established data, but the issue is not important to the present subject, and it will be sufficient to call the active force one of pressure alone, and the resistance, or loss, a result of an imperfect riddance of the water on the reverse or discharge side of the vanes after it has performed its work by pressure, impulse, or otherwise.

Following this method of operating to its constructive features, it involves closed vessels, or conduits, not only to the water wheels, as in other cases, but around them. They must be enveloped in the fluid that drives them, and contained in cases strong enough to sustain not only the static head, but also the effect of water concussion, and in most cases afford support for the wheels themselves and their shafts.

The bearings of the wheels have to sustain the weight of the running parts, also in many cases a pressure of the head, equal to the area of the issues multiplied into the head. The wheels are submerged, placed at the bottom of the head or near it, inaccessible to observation, and also for repairs, calling for unusual and expensive provision in the way of bearings and other constructive features, including extra strength of all parts. The hydrodynamic conditions both of entrance and discharge call for complicated forms that cannot with safety be built up, and pressure turbine wheels thus become large and expensive castings, the value of which depends upon the integrity of every part. If a vane be broken or imperfect, the whole wheel is lost. The diameter being limited because of first cost, a limit of rotative speed is reached at heads of 50 feet or so, and even at that head the bearings have to run under undesirable conditions; in other words, this type of wheels does not permit control of rotative speed, that being limited by both first cost and operating conditions.

Turning now to the other type of wheels, but little known in this country except on the Pacific Coast, the impulse class, and assuming that the force of spouting water is equal to its gravity, less an inconsiderable friction in orifices, the question arises, why has not the evolution of water wheels followed on this line, instead of pressure, for all except low heads?

This is a very important question, one that may well engage the attention of this society, and one that calls for explanation such as will be by no means easy or apparent. It is true that with that class of impulse wheels called "undershot," and some other cruder forms operating by the impulse of spouting water, the efficiency attained has been so low as to lead to the conclusion that the losses were inherent in the method, or mode of operation, and this opinion has, it seems, become general, without any one very closely inquiring into the matter.

That the efficiency of tangential wheels driven by impulse is as high as can be attained by pressure turbines, has been proved by numerous experiments here, also by some recent tests at Holyoke, Mass., and is beyond controversy. It has long been settled on this coast, and as a problem no longer exists. No one here would expect under a head of 50 feet or more to attain with any known type of pressure water wheels a higher efficiency than is given out by tangential impulse wheels; but this state of opinion and practice is confined to narrow limits now, and is the more to be wondered at when we consider the rapidity and completeness of investigation in other branches of dynamic engineering at the present day, especially when the economic and constructive conditions so much in favor of the impulse type of water wheels are taken into account. These we will now consider in a brief way.

There is a wide difference between a water wheel driven by impulse and one operating on the pressure system. The first cost of the former, for a given power, is one-half as much, and its maintenance is still less, in proportion.

Figuratively speaking, when a wheel is changed from the pressure to the impulse system it is taken out of its case, mounted in the open air, in plain sight. All the various inlet fittings are dispensed with and are replaced by a plain nozzle and stop valve. Its diameter is made to produce the required rotative speed, whatever that may be. The shaft and its bearings are divested of all strains except those of gravity and the stress of propulsion when the water is applied at one side only. Most important of all, there are no running metallic joints to maintain against the escape of water, no friction and no leaks; there are, indeed, no running joints or bearings whatever, except the journals of the wheel shaft

The effect of grit and sand is eliminated, both as to vanes and bearings, and there are no working conditions that involve risk or call for skill. If a vane is broken, another one is applied in a few minutes' time. If a large or small wheel is wanted, the change is inexpensive and does not disturb the foundations or connections.

Capacity is at complete control; the wheels can be of 10, 100, or 1,000 H. P., without involving expensive special patterns. The

* A paper presented at the San Francisco Meeting of the A. S. M. E.

speed of rotation is not confined to commercial dimensions because of patterns or other causes. It is merely a matter of choice with the purchaser or maker.

Now granting the efficiency of impulse wheels, which, as before remarked, can hardly be called in question for all heads exceeding 50 or even 30 feet, and conceding the constructive and operating advantages just pointed out, the question at first named arises, why has the evolution of water wheels during fifty years past been confined to the pressure class? also, why has it been proposed at Niagara Falls to employ pressure turbine wheels under a head of 100 feet or more, when the conditions point to the better adaptation of open, or impulse wheels?

It is not necessary in such an inquiry to discuss the problem of horizontal and vertical axis, or other local conditions, in the case of the Niagara plant, or in any other case, further than to say that the pressure class of wheels offer no advantages not balanced by equal or greater disadvantages, as will no doubt appear if there should be discussion of this subject before the society.

Besides the object of this communication first named, there is the further one of calling the attention of the members present to the impulse or open water wheels so extensively employed on this coast, and to suggest that, if possible, they manage to see such wheels in operation under various heads, especially under high heads. In observing a machine of any kind in motion, there are impressions gained which cannot be conveyed by description, but I warn every one against inference from this remark that the tangential water motor wheels on this coast are not scientifically understood and treated. The problems involved may not be so many or so intricate as in the case of pressure turbine wheels, and this is fortunate, because the literature of the latter is one of much perplexity to any but skilled mathematicians, and for that reason has not been of so much use as it ought to have been in developing the wheels.

In this country—and it is a most commendable thing to mention—the pressure turbine by an inward flow, or an inward draught, has been greatly simplified in construction, cheapened in first cost, and at the same time better adapted to impure water, without losing anything in efficiency. I believe the inward flow turbines made by the Risdon Company at Mount Holley, New Jersey, have in public tests on more than one occasion shown an efficiency as high, or even higher, than the more finely fitted Fourneyron and Jonval types.

The record of American engineers in this branch is one of which they may well be proud; and now that impulse wheels of the Girard type have made much progress abroad, and have here in California been modified much as the Fourneyron and Jonval wheels have been in the Eastern States, it is quite time more attention was bestowed upon them in other parts of the country. The analogy in the two cases is marked. By an inward flow, American makers reduced the running parts, or the wheel proper, of pressure turbines to a small diameter, increasing its speed accordingly. This lessened the weight and cost of the wheels in the proportion of their diameters, and at the same time dispensed with the accurate fitting involved in the outward and downward flow turbines; and this, as before said, has been done without sacrificing efficiency.

The tangential type of open wheels has been similarly dealt with here in California. The running water joints have been wholly dispensed with. The construction has been cheapened one-half. The round jet has been applied in the most simple manner, with an increased dynamic effect, and the efficiency attained is believed to be more than is reached by the finest examples of Girard wheels in Europe.

Conceding these statements and facts brings us back again to the query forming the subject of this communication; namely, Why has the evolution of water wheels followed on the line of *pressure* instead of *impulse?*

Tail-stocks for Lathes.

BY PROF. JOHN E. SWEET.

In discussing the point with Professor A. W. Smith as to which was the better name of the two, *tail-stock* or *foot stock*, for the well-known piece of machinery, I was predisposed in favor of the latter as the more elegant expression, but being convinced that the former was the more consistent I have adopted that for a heading, not forgetting, however, that it is vastly more important that we make the thing itself right than that we find the right name.

It is more than probable that the slide lathe as the English call it, the engine lathe or iron lathe as we know it, has received more study, has been constructed by more individuals and firms, and has assumed more shapes than any other machine tool, and it is equally probable that the tail-stock has taken about as many shapes as any other part of the machine. If there is any such thing as right and wrong, good or bad, agreeable or ugly, they cannot all be the best. It is more than likely there are two or three good forms, but all things considered it may be that one of the two or three is better than the others, or that one form is best for one size of lathe, and another for another size.

To consider the best form to resist the strains, it is as well to omit the parts that have no bearing on the question, as has been done in some of the illustrations that follow.

The form shown in Fig. 17 for an uncored casting belongs to a class which is likely as good as can well be devised for lathes of from 16″ to 36″ swing. Assuming the strain to be in the direction of the arrow, the front web *A* prevents lifting, the back web *B* prevents the spindle tube from going down, and the central web *C* prevents all springing back. The spindle or poppet barrel can project over towards the head center, as it ought, and may far more than shown, and the whole looks well. Looking from the head stock end, the form of the webs *A* and *B* is often made as in Fig. 18, which is not as rigid as if like Fig. 19, but the latter brings the metal at *d* in the way of the compound rest or tool. The form given in Fig. 20 would be better all around, and, unless for some reason not considered, might be the best form, but does not look as well as Fig. 17. To make the curved lines in this case equal the straight requires a better artist.

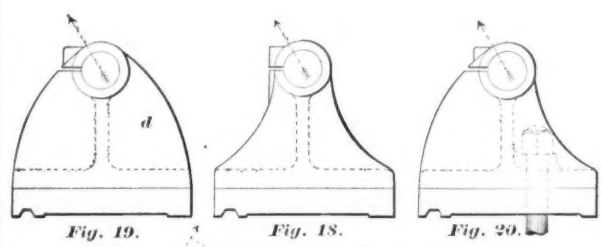


Fig. 19. Fig. 18. Fig. 20. Fig. 17.

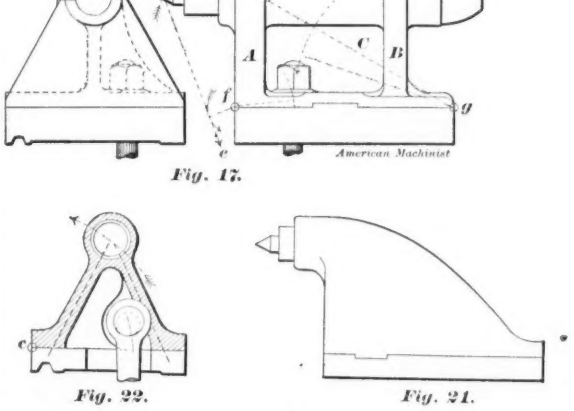


Fig. 22. Fig. 21.

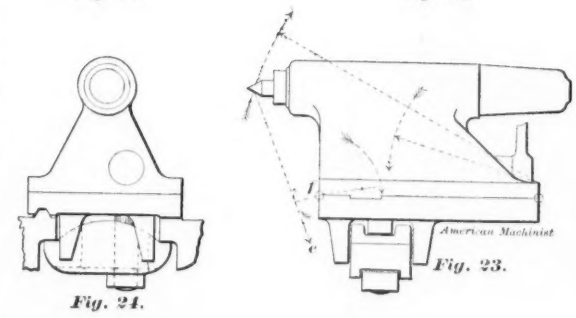


Fig. 24. Fig. 23.

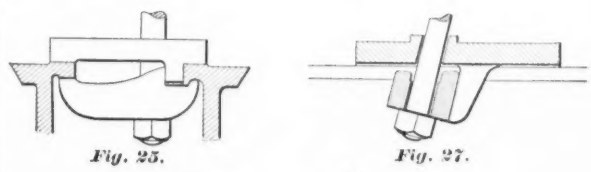


Fig. 25. Fig. 27.

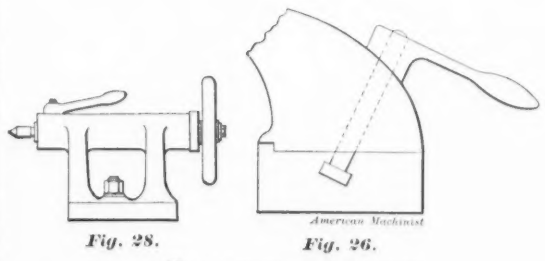


Fig. 28. Fig. 26.

TAIL-STOCKS FOR LATHES.

When the tail stock is of the cored construction, the form shown in Fig. 21 is as strong as it well can be. It does not appear possible to make it stronger by adding metal, or to take away metal without making it weaker.

The cross-section shown in Fig. 22 is worthy of a second thought. It will be seen that the metal in the web is equally disposed each side the line of strain. This brings the casting well out of the way of the compound slide, and makes a very rigid casting for its weight.

Figs. 23 and 24 are the same as 21 and 22, with the tube for spindle and screw added, which in no way weakens or affects the strength.

The strain on the center when taking a heavy cut tends to lift the tail-stock or rotate it around the center *e*, Fig. 22, and the binding bolt is in better position to resist that strain the nearer it is towards the head-stock. When two bolts are used it is the front one that takes the strain, except when the strain is due to the load on the center, in which case the strain is in the direction *e*, Fig. 17, which brings a lifting strain on the binding bolt, as it tends to rotate the tail stock around the center *f*, but in this case the strain on the bolt will seldom exceed the weight on the center, even with the bolt as shown.

Various practice, if not various opinions, exist as to where the set-over joint should be. That the joint should be where it has the longest lever arm to resist the strain would hardly seem to be open to question. The tendency is to rotate around the point *g*, Fig. 17, and the place for the binding bolt near the head-stock end, and, too, for the reason that the strain tends to push the tail-stock back, as shown in Fig. 20; the bolt can properly be placed nearer the front, as shown in Figs. 17, 20 and 22.

To maintain the tail-stock in perfect alignment, the Sellers plan, Fig. 25, or a modified one by Landis Bros., Fig. 26, of drawing it over against a straight edge, is good, and has construction advantages over the common double V plan, except where the girts are omitted in the bed, and some scheme is necessary to hold the two sides of the lathe together—a style nearly obsolete. The construction advantages of the Landis plan are that the edge can be much more easily made straight than the two Vs, four sides of which must be made both straight and parallel, and if it becomes necessary to swing the tail stock to get perfect alignment in the Sellers and Landis plans it is only a matter of a little scraping, and that scraping has no effect on the vertical height or alignment.

Quite a common oversight is that of leaving the cross-bar inside the bed free to swing. Horns cast on the lower piece, as shown in Figs. 23 and 24, prevent this, so that the least movement of the binding lever releases the tail-stock or binds it. When the cross-piece and binding bolts are free to swing, it is necessary to slack back the binding screw a long way, or the cross-piece will swing up and catch; besides, if the bolts get at the wrong angle, the tail-stock is quite sure to slide back until it comes to a vertical position. It is hard to find any place in the whole machine where so few cents will add so great convenience. With the binding bolt set at an angle, as in Fig. 27, which, as a matter of fact, is right, the two horns would be sufficient, and when the bolt is set tight enough to hold the other strains it will never slide back. The angle given in the cut is much too great.

The spring in the tail spindle and center, and the elasticity in the binding bolt or bolts, are the weak points in the whole structure. To remedy the latter it is customary to put in more bolts, but from the consideration of the strains it will be seen that the extra bolts do but little good, and add to the trouble in shifting. A far better plan is to make the one bolt equal to the demand, and then there is but one to operate. As to the springing of the poppet spindle, it may be that the foreign plan shown in Fig. 28 is much better than our own, though in many cases the extra projection may not be needed; when the projection is necessary the projecting sleeve is far stronger than the poppet spindle, and it gives room for a wide slide rest, whereas in adopting the narrow slide rest and the short overhang of the tail stock, we may have accepted the greater evil of the two.

In the foregoing an attempt has been made to point out a process of reasoning, which, if correct and complete, ought to aid in determining which are good and which are bad forms, and at least set students in machine design to thinking.

America's Fastest Train.

The seventy-minute flyer which the Reading Company put on its Atlantic City branch on Saturday is claimed by the officials of that company to be the fastest scheduled train in America, if not in the world. Ten minutes are allowed for the ferry trip from this city to Kaighn's Point, leaving sixty minutes for the 55.5 miles from the station to Atlantic City. For the first two miles, however, no speed can be made on account of the grade crossing of the West Jersey Railroad, so that as a matter of fact the remaining 53.5 miles have to be made in fifty-four or fifty-five minutes, which is practically sixty miles an hour for that distance. On Saturday the train, which consisted of eight cars carrying two hundred and eighty persons, pulled out of the station a minute late, but this was made up on the run, and Atlantic City was reached exactly on time. For a few miles the Empire State Express of the New York Central Railroad is scheduled to run at a rate exceeding sixty miles an hour, but for a distance as great as that from Philadelphia to Atlantic City the Reading's seventy-minute flyer is believed to have no equal in speed.—*Philadelphia Record.*

A reporter recently interviewed Edison on the subject of the steam engine, commencing by asking "the wizard" if the steam engine must go. In reply he was informed that the steam engine must certainly go, *i. e.*, in the way that it has been going for some time, to furnish power for generating electric currents, and for other purposes. This interview is being industriously reprinted in all

the papers as though it contained new and important information, as, in fact, it does to many, including most newspaper men. But Mr. Edison having spoken on the subject, there is no doubt but that many persons will now awake to the fact that electricity is not going to be the prime mover of everything terrestrial.

Grinding Machines.

We illustrate herewith some grinding machines which have recently been brought out by the Sterling Emery Wheel Co., of 174 Fulton street, New York City.

Fig. 1 shows the machine designated by the manufacturers as the "D," in which the length of the spindle is 60″; distance between wheels, 40″; diameter of spindle in the bearings, 2¼″; length of bearings, 10″. It is intended to run two 26″ wheels. This cut is given as representing a complete line of these machines, which are practically alike except in size, and which are adapted to any of the work about machine shops, foundries or manufactories which is usually done on such machines.

Fig. 2 represents what is called the "E" machine, which is also representative of a class of similar machines intended for only one wheel, which is placed between the bearings. In this machine the spindle is 41″ long, with bearings 1¾″ diameter, 8½″ long. It is intended to use a 24″ wheel. This machine is especially intended for the heavier work usually done in foundries, and where only one wheel is required.

Fig. 3 is a bench machine with tight and loose pulleys on the spindle, so that there is no need for a countershaft. It has a spindle 20″ long with bearings 1 1/16″x4½″. This machine is designed for two 12″x2″ wheels.

Fig. 4 shows a column which is furnished with this machine when desired, so that it may stand upon the floor.

In the case of the larger machines the rests can be used on either side of the wheel, and where two wheels are used they are sufficiently separated so that two men can work at the machine at the same time without interfering with each other.

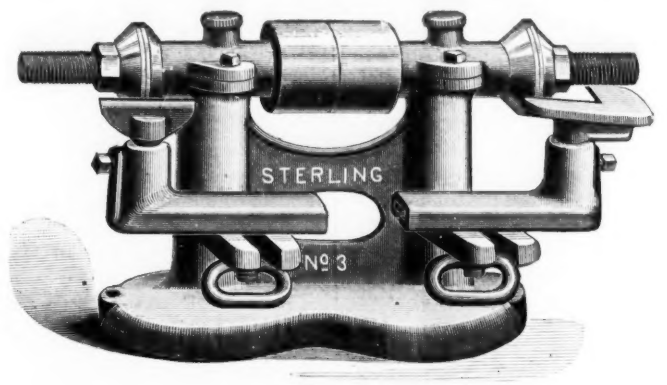


Fig. 3.

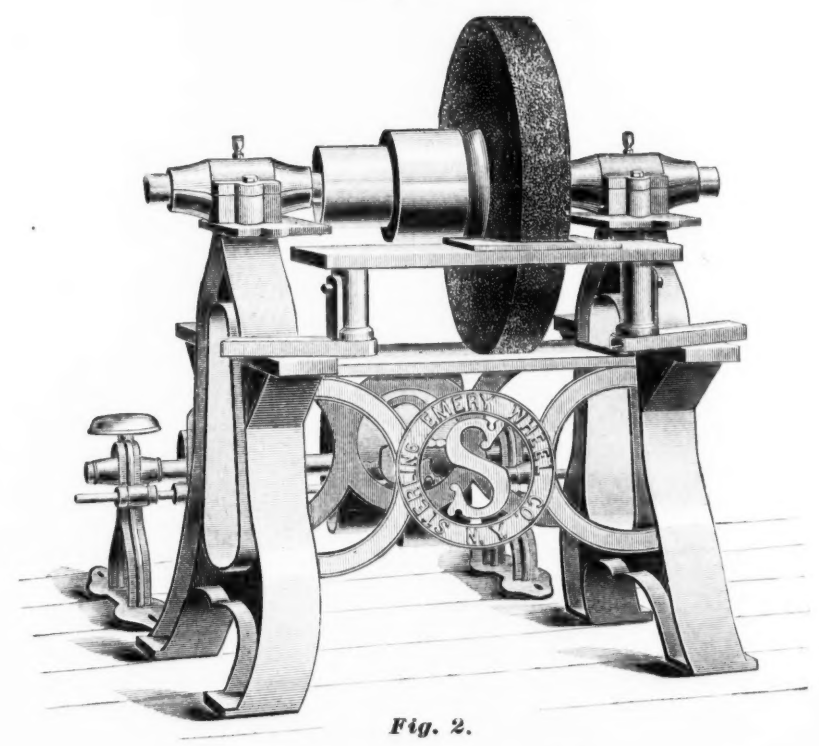


Fig. 2.

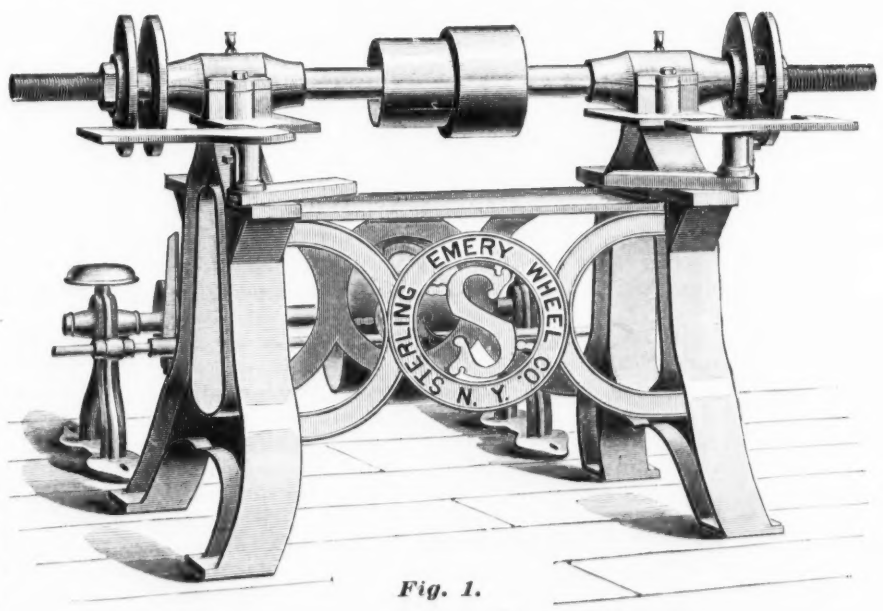


Fig. 1.

Fig. 4.

GRINDING MACHINES.

An Elevator Experience.

A Chicago engineer, who prides himself on his years of experience, lately met with a condition which was beyond his comprehension. He went to pack the piston of a Hale elevator, in the building where he was employed. He left the discharge valve open while he slacked up the glands and packed the stuffing boxes. Of course, under these conditions, air got into the cylinder and the water got out. After he had finished packing, he turned on the water from the supply, but neglected to open the air valve. In the meantime the tank on the roof became empty, and his efforts to start the elevator availed nothing. For several minutes he worked with the elevator rope, but there being no water, the elevator did not move. Presently he bethought himself to examine the water supply, and finding this lacking he started the pump and filled the tank. His troubles then began in earnest, for so soon as the water was introduced into the cylinder, it being full of air, the elevator commenced to dance, springing upward two or three stories with a rapidity that almost took the breath away, and again descending in the same spasmodic manner until the engineer was frightened nearly to death and commenced to call for assistance. His predicament was somewhat alarming, for, at the least opening of the valve, the compressed air in the cylinder would shoot the elevator many feet upward before the valve could be closed, and then, by moving the valve too far, the elevator would drop again. His cries for help soon brought an engineer from a neighboring building, who, taking in the situation at a glance, and understanding the difficulty, reached the top of the cylinder, opened the little pet cock which served as an air valve, and, so soon as the air was exhausted from the cylinder, the elevator became the same old tractable machine as before.—G. P. in *Stationary Engineer*.

There is just now a revival of plans for making diamonds. The constituents of a diamond are fairly well known, but when it comes to imitating nature in their production it is—another thing.

Engineers' Wages at Sea.

In the parliamentary paper on "The Progress of Merchant Shipping" there is a table which shows the wages of engineers on different classes of steamships over a period of years. It appears from this that for vessels of and above 2,000 tons the monthly pay of first engineers was for 1855—the first year recorded—on the average £21 1s. 4d.; but it fell in successive years until it reached £17 10s. 8d.; and from that rate it has fluctuated a little upwards. It is to be added that there are known to be a few instances of chief engineers who receive £25, "or even more; but these, being special cases, have not been included in the average." From 1880 up to 1887 there was an increase in the rate, the average for the last-named year being £19 5s. per month; but it fell during three successive years, whilst in the past year it would seem from the parliamentary paper that the average rose again to £19 5s. The rates paid to other engineers—second and third—moved in the average somewhat similarly, and so in the cases of smaller vessels; so that it would seem that the rates of wages rise and fall with the condition of the shipping industry, whilst a further corroboration is given to that conclusion by the knowledge of the fact that there is now in course of arrangement some reduction of the wages of engineers in certain types of steamships, both in Cardiff and in the northeastern ports. The same return gives a table of the rates of wages that have been paid on the average to firemen, and it is noteworthy that the wages paid to the "leading firemen" were for the past year about the highest, and in some instances actually the highest that are recorded in the list which usually covers the period from the year 1855. In the case of the steamers of and above 2,000 tons, the wages of the leading firemen averaged £4 7s. 6d. per month as far back as 1855, but for the past year they had risen to £5 5s. 2d., while those of firemen generally had risen in a somewhat similar ratio. Of course the transference of so large a portion of our merchant shipping from sailing to steam vessels in that period must have greatly developed the demand for both engineers and firemen, and thus the advance in the rate of wages is accounted for in degree, but there is no explanation of the reason for the unequal movement of the two classes in that time. In the early years it was more difficult to obtain men, but the years have seen the upgrowth of many, and experience adds now yearly to the supply, whilst it is doubtful whether the demand is likely to know as rapid an increase in the future as it has done in the past, though combination now may affect the wage.—*London Engineer*.

The Overhead Trolley.

BY PROFESSOR JOSEPH TORREY.

Before J. H.'s note appeared I had some notes down on the above subject, but had hesitated about sending them, thinking they would not be of general interest to your readers. It begins, however, to appear as if the subject was of some interest, so perperhaps I may be permitted to add a few words to what has already been said. The question, What is the proper attitude for mechanics and engineers to take concerning the trolley? is too important a one to be either set aside or discussed carelessly.

As is well known, the city of Boston, near which I have the excellent fortune to reside, is now pretty fully equipped with electric cars on the overhead trolley system. Boston is blessed with narrow and crooked streets. About every imaginable obstacle to the successful operation of an electric railroad, or any other rapid transit system, exists there. Numerous complicated crossings where several tracks intersect, make heavy strains on the guys and poles. There are plenty of sharp grade curves at very crowded points. Then again the suburban traffic is exceedingly heavy, and most of the suburban electrics come right into the crowded part of the city. The cars are mostly the long ones, with six or eight wheels, and having seats for about thirty-six. As a matter of fact I have seen eighty passengers on such a car, and sixty or seventy is not an uncommon figure. Tremont street, particularly between Park and Boylston streets, is a very interesting and impressive sight from about five o'clock in the afternoon on. The problem of handling a tremendous rush of people, all of whom are in a hurry to reach their homes, is presented there in all its complexity. Every car that passes is jammed to its utmost capacity. To handle such a car in a crowded street with numerous crossings thronged with hurrying people is a task to try the nerves of any man.

The ruling spirit of this very busy scene is the overhead trolley, the main objection to which is that it is *overhead*. Is the war against overhead wires warranted in all its severity? I can understand how it might be perfectly justifiable in case of such wire and wiring as was in vogue ten years ago, but should not "the punishment fit the crime" to some extent?

Just now we are decidedly in a rut as

to methods of hanging and securing wire, but I can conceive of conditions under which an overhead wire would involve no more danger to the public than an underground one, and these conditions are not unattainable. There is a special reason to my mind why we should be particularly patient with the electric railroad overhead wires. The electric railroad is one of the great agencies for bettering the condition of the working people. In Boston the amount accomplished in this way is almost incredible, and hundreds of families who formerly lived in tenements now live in comfortable quiet little houses in the suburbs.

In just the same way there was a time when, as it seems to me, it was a public duty to bear with the arc light wires with their insufficient insulation and poor construction. The change the introduction of the electric light made in some small western towns eight years ago or thereabouts cannot be understood or appreciated by any one who has not been on the ground and witnessed it. I do not mean that all criticism should be silenced, but there is a vast difference between the criticism that destroys and that which builds up. The former costs nothing. Any newspaper reporter who knows as little about the subject as a cat does about Sanskrit, can reel it off by the column. Moreover it is a fact which, it seems to me, is a very noticeable and lamentable one, that in almost every case, especially of criticism on any mechanical contrivance or plan, the destructive criticism is the first to appear, and is all too seldom followed by any broad, intelligent and constructive consideration of the subject.

It seems to me that most of the criticism of the trolley belongs to the first class. I read an article only the other day in which it seemed as if the writer must have ransacked all electrical history for the last ten years to make out a case against the trolley. I went impatiently from line to line expecting every moment to find the place where he would begin to really criticise and put something in the place of what he had torn down, but there was no such intention in sight.

Now if I understand the matter aright, the trolley is simply a scaffold in our rapid transit structure; but have we built above it yet, and are we ready to abandon it? If so, what are we to put in place of it? If not, then what sense is there in undermining it? We are *not* ready to leave it. The trolley is the only device that has so far been able to put electric railroads on a basis permitting economical and successful operation, and making it possible to enlist the necessary capital for installing the large plants which have grown up all over the country.

Rumor has reached me within a day or two of a new system in operation in Chicago which employs no trolley, but I know nothing further about it. If it is a success it will be welcome, but unless its economy is comparable with that of the trolley it will not be a success.

People are constantly talking about storage batteries, and their possibilities in running street cars. The storage battery has a field of its own, and will, probably, in some form or other, be a factor in the electrical development of the next twenty years; but does it really look as if it were taking a step forward to multiply the number of times we convert energy? I believe myself most firmly that we are all on the wrong track with all our dynamos, motors and steam engines. We are converting energy too many times now, and the great step will be when we only convert it once; but is that any reason for inveighing against steam boilers with their numerous explosions and steam engines with their fly-wheel accidents, both of which have caused more deaths in the last year than all the trolleys in Christendom? By no means. It is every one's duty to use them for every ounce there is in them. They are the agencies which are to teach us better mechanics in years to come.

It takes no great mental acumen to see the faults of the trolley. It is all out in sight, poor thing! and every wink of its keen eye is seen and recorded, and, by the way, in these days when all our street railroad road-beds have to be strengthened, and are in an almost constant state of upheaval, what other device would permit of working temporary switches and sidings as does the simple, manageable trolley? It is going to be some time before our road-beds are up to the demands of the heavy traffic, and, meanwhile, it seems pretty evident that the trolley must stay and not go. Another thing worth noticing is that many of the faults of the trolley are not inherent but constructive ones, and are capable of remedy. Still it is not a subject for superficial thought, and anyone who undertakes to improve it will find that it has not been contrived without study.

Finally, coming to the question of danger, I think Mr. Poole is substantially correct in stating that there has been no loss of *human life directly traceable to the trolley*, though that is a somewhat ambiguous provision. On the whole, I cannot see that the trolley is any more dangerous than the cable, for instance. The grip is an element of more or less uncertainty. Wear is very severe, and if some device like the Paine grip is used, accidents, such as took place on the Brooklyn Bridge a few years ago, may occur. The breaking of a cable is an exceedingly awkward circumstance, and the slot in the track is not guiltless by any means. For such a city as Boston, electric cars, such as are in use now, are a better temporary solution of the problem than cable cars would be, and even in Philadelphia, where either cable or trolley would have very favorable conditions, the choice which has fixed on the trolley seems to be a wise one.

The problem of rapid transit is an entirely unique one in America. It has no approach to a parallel anywhere in the world, and the most advanced plans are merely the beginning of a solution. The great difficulty is that people's minds work so much alike. There are always more people who want to travel than can. On any line where the cars are crowded they will always be crowded, unless the number of cars is so increased as to make rapid motion impossible. If more cars are added to a line it is seldom that the relief is more than temporary. The travel comes up to its capacity every time.

I know of no greater or broader problem in the world than this. It is precisely the kind of questions our technical school engineers ought to be trained to consider. I say *trained*. You cannot *fit* a man to cope with such problems in any school. A man must be born with the engineering sense in him, but the technical school can cultivate and develop such men if they will.

LETTERS FROM PRACTICAL MEN.

Annealing and Cutting Off Steel.

Editor American Machinist:

Although the subject of annealing steel has had some space in your columns, I am certain that it wants more, because in a shop directed by one of your constant readers I very recently saw fifteen hours spent on a little piece of hard steel, which three hours would have finished had the steel been soft, had the cutting tools used been dressed and hardened in a clean fire, and the job been done as it might have been done. I not only saw this time spent, but I helped to pay for it, which decidedly emphasized my opinion of the time wasted.

There is only one way to treat steel in the machine shop, and that is to cut it up as soon as may be after it enters the shop door, and anneal it in powdered charcoal in cast-iron boxes, with covers bolted on. I have never seen steel so annealed "cling" in working as mentioned by Mr. Goodyear. I have seen mild steel—machine steel—which was very soft, which worked in the lathe with a "cling" almost as bad as that of copper. I once had a great deal of such steel to work in the form of crank-shafts, and it was not only expensive and difficult to work, although extremely soft, but it also wore badly, and its use was finally discontinued solely because of its softness and its "clingy" working. But I have never seen a tool steel which was annealed "too soft." I have seen plenty of it which was "water annealed" soft with hard "pins" in it, and worked it in that agonizing form, and have "water annealed" many a job myself, knowing perfectly well that I should not do so, because there is no certainty as to the result of a water anneal. But the job was in a hurry; a broken tool, perhaps, to be replaced; a man idle; a contract already scant of time, and the steel standing in the rack in the bar, just as it came into the shop. Under those circumstances it takes lots of nerve to do anything except to rush at the job headlong, trusting to luck to get through somehow in less time than would be used if the stock were rightly treated. Every man who has ever been any part of a tool maker knows all about it. Hence I say that in *all* cases tool steel stock should be cut up as soon as it comes into the shop into lengths that will go into the annealing boxes. Tools are of such varied lengths that cutting in small pieces does not entail waste; the smallest and shortest pieces of tool steel always find a use. I have never seen steel annealed at the mill so well as it can be annealed in boxes by packing in charcoal. And I do not think it possible to anneal steel in a short time in the best manner.

At the time of the Chicago fire a large stock of Thos Firth & Sons, Hobson's & Jessup's, and Black Diamond (Park Bros.) steel was "in the anneal" for several weeks—I think about two months, and was yet warm to the hand when it was reached.

This stock had been heated precisely right, was not scaled at all, and was perhaps the only thing that was made of more value by passing through that conflagration. It was perfectly free working, could be cut with a good pocket-knife, and was in every way as good as it ever was, and while it lasted there was joy among the tool makers of Chicago. "Relic" steel we called it, and it was with sorrow that we came to the end of this accidentally annealed stock. Soon afterward I had a large job of tool making and special machine building, and in the plant was an old muffle, used I believe, formerly, for tempering. I had some cast-iron boxes made of suitable size, half an inch thick, with flanges all around the top an inch wide, and cast-iron covers same thickness to bolt on with half-inch bolts; I ordered in a good stock of Jessup tool steel, octagon and flat stock for dies, cut it up, and packed it in the cast-iron boxes with half an inch of charcoal, coarsely powdered, between the steel and the sides of the boxes, and about ¼ inch of charcoal between the layers of steel; holes bored in the covers permitted ¼" test wires to be packed in with the steel, and stick out through the covers after the covers were bolted on. I had a good, reliable "cub" who had had some experience in the blacksmith's shop, and he built a hard coal fire in the unused muffle and warmed up the boxes of steel and charcoal until the ¼" test wires showed dark red the whole length when pulled up out of the boxes; then the muffle was bricked up tight without disturbing the fire or the boxes in any way, and the whole thing left to itself for two weeks. At the end of that time the muffle was opened, as it had got cold on the outside. The steel in the boxes was still warm to the hand; the charcoal in the boxes not wasted at all, and the steel stock was perfectly clean and mottled with case-hardened colors—pleasing to look at and to handle, and delightful to work, and for the three years of my stay in that place I had every pound of tool steel annealed before it was brought into the machine shop, saving, I have no doubt, in the mere cost of drills and files, more than the annealing cost, to say nothing of the weeks of tool maker's and machinist's time gained, and the superior quality of work turned out.

I recently saw in a well-known shop in Connecticut perhaps half a ton of assorted tool steel in full length bars lying on the floor, which had been through the fire; the superintendent told me it had been annealed in a long muffle, in an open hard coal fire, and that such was their practice The stock had been scaled in places, and was not clean to handle, and I do not think it could have been uniform in softness. For reasons, I did not care to inquire very closely, but I doubt the correctness of such practice. I should certainly, in the light of my own experience, question the judgment of any "super" in charge of tool makers who did not pack tool steel for annealing in boxes with charcoal.

At this point the question of how to cut up this unannealed tool steel comes in. Most of us are fairly familiar with the screech of the square-nosed cutting-off tool in the agony of its progress through the bar of steel held in the jaws of the shaper vise. We know how the foreman feels as he sees the tool go from the shaper to the grindstone and the tool dresser, backwards and forwards—how the man who is cutting off that piece of steel oils the cut, and holds the tool-post down when the tool begins to jump up—we know all about that, and what is more, we are not quite sure what to do about it. Of course the foreman can swear softly to himself, and ask the man with as much calmness as he can assume if he is sure the tool is hard, and the man can answer with all respect to his foreman that the tool didn't seem to be much harder than the stock, and then the foreman can walk off and wonder whether it is himself or the hand who is to blame, and the cutting-off tool can continue to screech.

The steel can be sent to the smith's shop and cut up, cold or hot—both ways are expensive and leave the stock in bad shape, and call for needless work in the machine shop in the way of squaring up the ends.

The steel can be broken in the press. Two supports, round edged to lay the steel on, and a "round V" edge punch, like a blunt cold chisel, brought down on the bar so as to very slightly bend it, and then after the bar is turned over, bring the punch down again on the opposite side, and the bar will drop apart in very fair clean line in the most surprising manner. This is, perhaps, the very best way to cut up, or rather *break* up, tool steel stock. In octagon shapes the break is almost as true and even as if cut in a cutting-off lathe.

The cutting-off lathe can be used for round, square and octagon shapes, and has such a range of speed that comparatively hard stock can be cut without trouble, by taking time. Last of all, a very lately introduced power hack saw seems a wonderfully good and efficient tool for cutting off steel. The price is almost nominal, and I have watched it working with admiration as to the results produced. I am sure I have seen tool rooms where this $25.00 rig would have saved its cost every single week. I trust that this saw may soon abolish the abominable practice of cutting off stock in the shaper, which is so destructive to the shaper itself and the temper of the tool, the workman, the foreman and the proprietor. Of course, in point of speed, breaking in the press leads anything else, but presses are not found everywhere, nor are they to be used without judgment, while the power hack saw comes easily within the intelligence of the most ordinary workman.

EASY WAY.

A Talk to the Boys.

Editor American Machinist:

While a great deal has been said and done to raise the trade of the machinist higher than it now stands, still there is one thing overlooked, and that is plain talks to the young men that are to take the places of the gray-haired machinists when the latter are unfit for work on account of old age.

I have been waiting for some one more able than I to write on such subjects to start the ball rolling, but as they are more interested in turning paper rolls right now than they are in our youths, I decided to make a break, with an earnest request that the rest of your readers will give their views on the subject.

Now, to begin with, our young men do not read enough, but on the contrary, a great many of them will declare (as I did at one time) that there is nothing gained by reading, and that they can learn more in a week by actual experience than they can in a month's reading.

To a certain extent this is true; but if they do not read then they will only be what my

father used to term "hand-workers," or, in other words, after some one else has made all calculations for them then they will be workmen enough to do the work.

Now, boys, it only requires practice to run a lathe or planer, but it takes brains and study for you to take a pair of dividers or compasses and lay out a correct gear wheel. You have the brains, that is, the majority of you have, and all you have to do is to study and you will "get there" some day, and the sooner you break away from the boys that spend their time loafing at night, the easier will be the task.

I wish you to understand that I have no desire to make old men out of you, or to say that you must not have your friends, for I think that the most miserable man on earth must be the one without friends. But I mean that you let your friends take care of themselves about four nights weekly, and that you devote these nights to study.

Do not make yourself a promise that you will stay at home four nights weekly, but if you decide to take the advice that I set forth, take it in the way that I advise you, and have four *special* nights, and regard these nights as if you have a special engagement, and see that you do not break this promise to better yourself. "Time will do the rest," and in after years you will be thankful that you have spent your time in reading on your own trade, and will wish that you had begun earlier. PRACTICAL MACHINIST.

Electro-Mechanical Engineers.

Editor American Machinist:

In a paper on Electro-Technical Education, read by Prof. R. B. Owens before the American Institute of Electrical Engineers, at their recent meeting, some definitions are given which are worth repetition, especially in view of the efforts which have recently been made in engineering journals to define the term mechanical engineer. Prof. Owens says:

"Between the scientist and skilled mechanic, or handicraftsman, is the engineer—the man who, familiar with the results of scientific investigation and methods, uses both, by the help of the mechanic's skill, to minister the more effectively to the wants and will of an ever-increasingly exacting public. To him alone we look for the solution of the problems of transmitting and distributing the power of waterfalls and fuels, the tunneling of our mountains, the building of our railways and steamships, as well as the more delicate work of flashing our thoughts and words from town to town, and from continent to continent. This field of work is so vast that of necessity it must be divided among specialists and sub-specialists; but since the 'Vril' of Lord Lytton's 'Coming Race' has shown itself so marvelously well fitted to do our every bidding, I believe a great portion of the work hereafter will be done by the electrical engineer." And further: "We must, I think, recognize three classes of electrical engineers in this country at this time: first, the installing engineer, who superintends the equipment of central or isolated electric light or power plants, electric railways, mining plants, etc., and runs the same when completed. In this class of work more than a knowledge of electricity is required. It becomes essential to have a thorough knowledge of steam engineering, track and pole line construction as well. He should be as well able to choose the best engine and boiler for a given set of conditions, and to install and operate them economically as he is able to choose the best dynamo, motor, line wire or lightning arrester. A practical knowledge of building foundations, laying out railway curves, running pole lines, is to this engineer a matter of greatest importance.

"The next distinct class of electrical engineers I would recognize are designing engineers, who rather have to do with the manufacture of electric apparatus than its installation. Such men design and superintend the construction of the apparatus put on the market by the several manufacturing firms, but rarely also have to do with steam engines, track construction, or pole lines. To this second class, a correct knowledge of machine design is of equal importance with a knowledge of magnetism and electricity, and it was, perhaps, of such men that Lord Kelvin was thinking when he said an electrical engineer should be nine-tenths mechanical and one tenth electrical.

"The third class of engineers are employed by standardizing bureaus, and in laboratories, to make tests of electric and magnetic constants, calibrate instruments, etc. For such work neither a knowledge of pole lines, foundations, or machine design, is so important as familiarity with delicate methods of measurement and skill in manipulating sensitive instruments."

In the same issue of the *Electrical World* from which the above is quoted, it is said editorially, in the course of comments upon this paper and another on the same general subject: "An attempt to be both a mechanical and an electrical engineer cannot but result in failure. The fields are too large for any man to attempt to master both."

Probably the above general definition of an engineer is as nearly correct as any general definition can be made, provided we add to it "the practical knowledge gained by experience and observation." The young graduate of one of our engineering schools is supposed to be "familiar with the results of scientific investigation and methods," but it takes years of practical experience and study of actual constructive work done by others, as well as continual reading, to 'keep up" with the advance in physical science to make an engineer of him.

The *Electrical World's* editorial comment, quoted above, should be italicized, as it is the soundest of common sense. Now read the definition of the first class of *electrical* engineer. He is, in fact, an experienced steam engineer, or he cannot select the proper types of engines and boilers, pumps, heaters, etc., for the particular locality, design a well proportioned plant, draw up specifications which are fair to all parties by being plain and explicit and thorough, without containing fads to annoy the manufacturer and waste money for the owners, put in suitable foundations, erect the plant and get it running on an economical basis; he is an experienced railroad civil engineer, or he cannot build the best track, all considered, or which will be the cheapest in the long run. In some cases he must have had experience in mining work; and probably he must be something of an architect and builder. In short, he must be a good deal of a steam engineer, and something of a railroad engineer, architect and electrical engineer. The electrical part of the work is apt to be far simpler and to require much less experience and theoretical knowledge than is required for the other parts, so it may be questioned if he should properly be called an electrical engineer.

To the definitions of the second and third classes of electrical engineers there is no objection, unless it be that the third class, inasmuch as they do not engage in constructive engineering work at all, might properly be called electricians. No one will question the correctness of classing as electrical engineering work the designing of dynamos, motors, transformers, etc., etc., the calculations for systems of conductors, and designs for electrical transmission of power generally. But when they are also to design the steam or water power plant from which the power is derived, the cars, the track, elevators, cranes, in short, everything that has any remote connection with electricity, it would be better to drop all special titles and call them general engineers. The only difficulty is that one man cannot cover the field.

It is probably generally true that the college-bred mechanical engineer who has had limited shop experience is apt to be deficient in shop knowledge, and, on the other hand, the shop-educated engineer is apt to be weak in his theory. If there was time enough for a man to get practical shop work in all lines, then take a broad college course, and then devote half of his time to study in order to keep up, we might have an all-round engineer, provided his brain held out. But the best that most engineers can do in the present age is to build a foundation of general principles in college, or in the harder school of self-instruction, to get practical experience in some one line of work, and then make a specialty of it. It is, of course, frequently difficult, and sometimes impossible, to draw lines dividing engineers into classes. The work of civil, mining, mechanical, electrical and architectural engineers overlaps and is subdivided too much for this, but we can use the titles to designate the general class of work, and subdivide according to specialties, as, for instance, into railroad, hydraulic, municipal, sanitary, steam, marine, cable, and the numerous specialties, such as machine tools, locomotives, refrigerating machinery, presses, air compressors, etc., which cannot be well defined by a single prefix, and are therefore generally designated only by the general class to which they belong. The general class of electrical engineers will doubtless become subdivided in the same way.

The rapid development of electrical matters is apparently the cause of another phase of the question of what constitutes an engineer. Hurry is said to be a characteristic of the American people, and it is probable that hurry is in one way or another responsible for much of the amateur engineering which now disfigures the country. It is certainly the cause of what some one has styled the crop of half-baked electrical engineers, for which time seems to be the only remedy. The design of an electric railway plant is not such a tremendous piece of work that one man cannot compass it, especially when boilers, engines, generators and motors can be obtained ready made in the market. But any power plant, whether it is to drive electric generators or a cotton-mill, should be *designed*, not guessed at. If planned and erected under the supervision of a man who can justly lay claim to the title of engineer, it should be able to successfully withstand criticism. But when we find in a power plant half a dozen engines of assorted sizes and makes, when automatic stokers are put in and shortly removed, when in one city we find large plants with water tube, porcupine, and plain tubular boilers, one railroad plant using slow-speed engines with countershafts, another using high-speed engines directly connected, one located near the middle of its line and hauling coal, another off to one side of its line, but running coal cars directly into the coal shed, we must conclude that there is evidence of a lack of engineering judgment, to say the least. The hurry on the part of corporations to get their roads in operation, and the hurry on the part of men who might become engineers if they tried, to become so without the necessary amount of hard work, the taking things for granted, and mistaking prejudice for judgment, and assurance for knowledge, are the principal causes of the present unhappy condition of affairs. An engineer should have sound reasons for the faith that is in him. He should be always prepared to answer Sam'l of Posen's persistent question: "How do you know?" There are too many men who are trying to be electro mechanico-railroad architects, without the necessary preparation for any one branch of the business. ARTHUR T. WOODS.

Fig. 1.

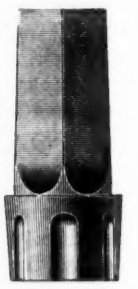


Fig. 2.

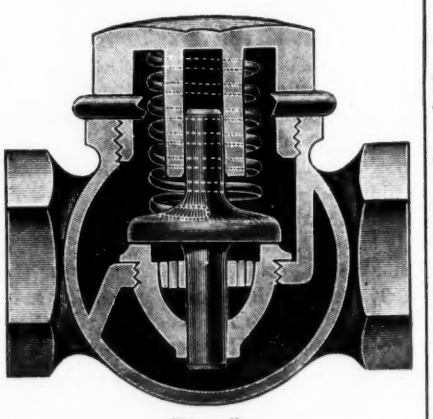


Fig. 3.

NEW NOISELESS CHECK VALVE FOR STEAM PUMPS.

Grinding Lawn Mowers.

Editor American Machinist:

In your issue of June 2, your correspondent "Wolrab" or Barlow, whichever way you wish to spell it, states that grinding lawn mower knives in a universal grinding machine is a howling failure. At present I am unable to say as to whether we may attribute the phenomenon to the difference in altitude or atmosphere. However, the fact remains that our grinder has sharpened every lawn mower blade in town during the last two seasons; the sharpening is done the same as we proceed with a milling cutter; the only thing essential is that the shaft is truly centered and not sprung; these conditions being O. K., nothing stands in the way of getting good results.

The builders of grinding machines, no doubt, will be surprised to learn that their universal machines are balked in so simple an operation as this. In the absence of some fixed grinding arrangement, fair results may be obtained with a file in the hands of a *first-class machinist*. I should never consent to have a machine of mine flooded with oil and emery. This cannot produce good work, and is certainly a very unmechanical way of doing a particular job, to say the least. L. C. SHARP.

New Noiseless Check Valve for Steam Pumps.

The check valve here shown is made especially for use in connection with steam or other pumps. All who are familiar with the use of check valves know the importance of having them as near perfect as possible. This is not so easily done, as the surfaces of the faces of the valve and its seat must be so perfect that they will not allow the steam or water to leak through, with the slight difference of pressure that there may be on the upper side of the valve disk tending to press it on its seat.

Check valves used on pumps are subjected to a more severe test in the way of hammering on their seats than when used in many other ways, therefore the face of the seats and valve disks are made flat, with large broad surfaces to prevent rapid wear from the shock when brought in contact during the process of opening and closing.

A spring is provided to take the shock off the disk when lifting, and allows the disk to raise only the required distance, to admit of the passage of the proper amount of steam or water, as the case may be, thereby obviating the disagreeable noise, and lengthening the life of the valve. It will also be noticed that the seat is removable, it being screwed in the body of the valve, and when worn out or leaky can be removed and re-faced, ground in or replaced with a new seat without removing the body of the valve from the pipes; the disk has stems on the top and bottom, which are guided in their movements at either end, one guide being in the seat, and the other in the cap.

The outside of the cap guide is made cylindrical, to form a guide for the returning spring, which is large in diameter, and long, compared with the work it has to do.

Figs. 1 and 2 show the removable seat and groove wrench for removing and replacing it in check valve.

The valve disks and removable seats are made of the best metal adapted to their use, as the weight of these two parts is very little compared with the body of the valve; it admits of the use of the best metal for these wearing parts. The valve is manufactured by the Albany Steam Trap Co., Albany, N. Y.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
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$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, JULY 21, 1892.

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Politics and Shops.

About this time the able editor of the political organ is engaged in a more or less frantic appeal to his readers to stand firm in support of the party, and in furnishing proofs satisfactory to him at least that the other party cannot possibly win, but that, if it should do so, the result would be instant, irreparable and hopeless ruin to all our institutions.

While we leave him to this congenial and profitable task, we may, it seems to us, discuss in a calm way some features of the situation of interest to all manufacturers, no matter what their individual opinions may be as to the respective merits or demerits of the various candidates or the parties they represent.

We shall, of course, hear a great deal about the certain ruin to come upon the country if one or the other party is successful, and of the vast numbers of American citizens who have no regard whatever for the welfare of their country, but are determined to ruin everything, if possible. It ought not to be necessary to remind ourselves that all this talk is pure buncombe. Both the leading candidates have served a term as President, and each has demonstrated that the country need not go to ruin if he be re-elected.

The general consciousness that this is so, and that this great nation of intelligent and energetic citizens, living in a vast territory of unexampled resources, is not going to be paralyzed and ruined by the turn of an election one way or the other, will, we think, as it ought, have its effect in maintaining confidence, and preventing the stagnation of business which in the past has resulted from political contests.

We have the utmost faith in the saving common sense and patriotism of the American people. We do not believe for one moment that any large proportion of them are fools, or that they have at heart anything else than the best interests of the country. This being true, it behooves us to keep cool, and to consider that, while the other fellow's views may seem foolish and unpatriotic to us, ours probably seem the same to him, and one may be as wise and patriotic as the other, "if not more so."

It is right, of course, that every citizen should have decided views one way or the other, and that he should maintain those views; at the same time according to others the respectful consideration he asks for himself. But in the interest, both of manufacturers and their employes, we ask them to consider the propriety and advantage of keeping politics out of the shops so far as possible. As a result of considerable observation and experience we are firmly convinced that neither the shops nor politics are benefited by being mixed together. Let the proprietors and the men take such action as seems best to them to advance the interests of their parties, but this should be done as citizens, and entirely independent of the shops, within whose walls the discussion of the subject should by mutual consent be tabooed, and the whole attention given to the business for which shops are carried on. Not only do we think this will do much to preserve harmony and mutual respect between employer and employes, but we believe it will be better for politics; for any action taken by a shop or manufacturing concern, as such, is, we think, nearly always more than counteracted by special efforts and criticisms directed against it, in which the manufacturers are usually very unjustly condemned, and charged with acting from motives never really thought of in most cases.

Let each American citizen, connected with a shop or manufactory, examine both sides and decide as his conscience dictates. The decision thus made will be right morally, and we believe, in the majority of cases, wise as well. But political arguments and discussion are just as effective outside of shops as within them. They cost the shop proprietor far less when held outside. And it should be remembered that where a proprietor brings into his shop, or allows others to bring in for him, politics of a certain brand, other brands of politics will certainly be brought in also. We firmly believe it will be far better for all concerned to keep all brands outside.

A Foolish Argument.

Mr. Henry M. Stanley, who has now become an English subject, has, it seems, been running for election to a seat in the English parliament on the Tory side, and amongst other foolish things has been advancing some remarkably thin arguments against the eight-hour movement over there. As we understand the matter, an attempt is being made to enforce an eight-hour day over there by legislation, which, we believe, is unwise; but such arguments as Stanley has been advancing will never make any one see the unwisdom of it. He is reported to have said before an audience of working people that he "never would have accomplished what he has done in Africa if he had confined himself to eight hours labor per day." This form of argument is old, and entirely without applicability to the case.

Most great and famous men have been endowed with the power to work long hours. Stanley by doing this upon occasion has made himself famous, has become wealthy, married a wealthy woman, and can now, as indeed he has done in the past, give himself long vacations and complete rest, during which he need not worry about where his bread and butter is to come from. Because he has worked long hours in accomplishing this, does it follow that men whose lot it is to work in English factories and coal mines, at monotonous, unvarying, and hard physical labor, not made lighter by hopes of any such rewards, shall make no effort to shorten their hours of labor and secure for themselves leisure to enjoy some of the good things provided for the inhabitants of this world?

John Ericsson was able to, and did work long hours during most of his life; but his physical and mental powers of endurance were quite exceptional, besides which he had the inspiration that came of knowing that he worked for himself, and, when successful, added to his fame, and often his income.

It must be obvious that his working long hours did not demonstrate that every draftsman or engineer should do the same, regardless of his own or of the average capacity for work, and of the reasonable prospects of reward for it. Eight hours per day has been demonstrated to be about all the average draftsman can really work, and except when each man can be so situated as to admit of his consulting his own feelings and disposition, the capacity and requirements of the average man must govern, not those of the exceptional or exceptionally circumstanced man.

Cyrus W. Field.

Cyrus W. Field, who died recently at his summer home at Ardsley Park, near this city, will be chiefly remembered for his connection with the laying of the first trans-Atlantic cable, the success of that great undertaking having been due very largely to his persistent faith in the possibility of its success, even under the most discouraging circumstances—a faith which he was willing to and did back up with his capital, besides inducing others to engage in it. It is, of course, probable that Mr. Field's interest in this was chiefly that of a capitalist aiming to make money, but, nevertheless, he is entitled to very great credit for the part he took in the enterprise, and especially for the fact that he persevered and went on to success when others were so much discouraged by the early failures as to abandon the undertaking. To him probably more than to any other man is due the fact that we have to-day instant communication with all civilized countries on the globe; the importance of this in many ways being really very imperfectly understood by most of the present generation, who know nothing practically of the previous methods of inter-communication.

Natural Gas in the Manufacture of Emery Wheels.

The writer of this, with the privilege of a newspaper man, recently took down some conclusions from Mr. C. H. Bush, Secretary of the Sterling Emery Wheel Co., whose works are at Tiffin, Ohio, and principal salesrooms at 174 Fulton street, N. Y. This company has gone through the experience of "burning" (we believe that is the term) their wheels by the use of coal and by natural gas. We should hardly care to state the saving by the use of gas, as our readers might think it a big story. This company is putting in a new kiln for large wheels, which must cool slowly for several days before it is opened. Natural gas is also used under the boilers, and for other heating purposes, with, it is said, excellent advantages. Natural gas is also used for lighting the plant.

The Jones Vestibule Sleeping Car Co., of Denver, Colorado, send us a circular describing their improved sleeping car, which seems to possess advantages over the Pullman or Wagner, especially in the arrangement of the upper berth, which can be entered at the end of the section from an alcove the width of one seat, which is curtained off and provided with a seat and wash-bowl. These and other improvements made in this car will be appreciated by those who travel.

Director-General Davis has asked the State Department at Washington to make public the following ruling regarding the placarding of goods at the Exposition: "Foreign exhibitors in the World's Columbian Exposition will be permitted to state upon placards attached to their exhibits the prices at which said products will be sold at the place of manufacture, and also the prices in bond and out of bond, or exclusive and inclusive of the customs duties in Chicago."

One of the novel exhibits in Machinery Hall at the World's Fair will be a model paper mill. It will be in active operation, and will show all the processes of paper making from the pulp to the finished card, which will be in the form of a World's Fair souvenir. Secretary Agnew, of the Paper Trade Club of Chicago, accompanied by several leading manufacturers, have recently made arrangements with Chief Robinson for the exhibit.

We have received a large number of letters and communications in regard to the overhead trolley system. It will be understood by our correspondents that the reason why their communications do not appear is because they traverse substantially the same ground. The burden of argument is decidedly against the trolley system.

Some time since we noticed a report that a box had been found at Helsingfors, Finland, containing a manuscript treatise on steam as a motive power, and parts of a steam engine, both manuscript and engine dating back to 1152. This now turns out to be a hoax, the result, probably, of the misdirected ingenuity of a university student.

The editor of the *Coal Trade Journal*, who is acknowledged to be the best authority on the question of coal in the country, recently gave testimony before the senate committee as to the increase in the price of coal. He saw no reasons for the advance in price except the operations of the coal combine.

Recently one of the ten-inch guns being proved at Sandy Hook sent a shot through a schooner somewhere off shore. There is no special reason to believe that the schooner was in reasonable range of the gun, but the shot got there. Ten-inch guns are dangerous things to fool with.

Just now, one of the most promising fields for invention is in the line of torpedoes. These are to be the destroyers, it appears, of the great ironclads of the future, which will be so protected that even modern guns will not pierce their armor.

The Pennsylvania Railroad Company is going to put in an additional span of 250 feet on the new bridge on the east shore of the Raritan River at New Brunswick.

There is another prospective rise in coal coming; we suppose we shall be told, from the cheaper production made possible by the trust.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(298) J. V. R., Richmond, Ind., writes: There has been a question raised in reference to the tempering of fluted reamers with three lips or more. Is a reamer of this character sufficiently hard to do all the kinds of work a tool of this character is required to do when it can be filed with a good sharp file? *A.*—We should not so regard it. A reamer capable of doing very satisfactory work may be soft enough to be "touched," as mechanics say, with a sharp Grobet file, but it should not be capable of being filed in the ordinary acceptation of that term.

(299) F. J. C., Cincinnati, O., asks: Have the steam valves of a Corliss engine more lead than the exhaust valves? *A.*—The exhaust valve has generally more lead than the steam valve. 2. Has the steam valve more lap than the exhaust valve? *A.*—In many engines the exhaust valve has no lap; in some the exhaust valve has more lap than the steam valve. 3. How much lead and lap should the steam valve have? *A.*—That depends on the size of engine. 4. How are the valves on a duplex pump set and adjusted? *A.*—That depends on the kind of pump. 5. How is the area of a safety valve $2\frac{1}{4}$ inches in diameter computed without the use of any fractions whatever? *A.*—We don't know, unless you obtain it by referring to a table of areas of circles. 5. Why do you allow 1 square inch of safety valve area for every 2 square feet of grate surface? *A.*—This rule is prescribed by the Board of Supervising Inspectors of Steam Vessels. Valves of this proportion will allow the escape of all the steam which the boiler is capable of making, without increasing the pressure in the boiler over ten to fifteen per cent. above that to which the valve may be loaded.

(300) W. M. A., Cleveland, O., writes: Inclosed please find sketch of a hollow shaft which carries a load of 4 tons at 27 inches from the end of bearing; the outer diameter is 9 inches; inner diameter 3 inches. How much will it deflect at the end of bearing? Please give the solution. *A.*—This may be considered to be a hollow beam fixed at one end and loaded at the other; the formula for finding the deflection is

$$d = \tfrac{1}{8} \times \frac{W \times l^3}{E \times I} \qquad (a)$$

in which d denotes the deflection in fraction of an inch; W, the load in tons; l, the length in inches; E, the coefficient of elasticity, which may be taken at 15,000 tons, and I, the moment of inertia, which for hollow shafts is equal to $\frac{.5.1416\ (R^4 - r^4)}{4}$, in which R denotes the outer radius, and r the inner radius. Substituting the foregoing values for the symbols in formula (a), and reducing, we get

$$d = \frac{4 \times W \times l^3}{141{,}372\ (R^4 - r^4)}. \qquad (b)$$

Now substituting for the symbols in formula (b) the values given in the example, we have $d = \frac{4 \times 4 \times 27^3}{141{,}372\ (R^4 - r^4)} = .005$ inch for the deflection.

(301) J. H. H., Buffalo, Wis., writes: Suppose that an engine is to be run at a piston speed of 300 feet per minute, its steam ports are $\frac{1}{10}$ of the area of the cylinder; valve, line and line inside; $\frac{1}{32}$ inch outside lap. Now, not having access to an indicator, is not the back pressure considerable? say cylinder 9x9 inches. To meet the conditions it is absolutely necessary to take steam practically during full stroke. Would it not be a decided improvement to increase the port area to $\frac{1}{16}$ the piston area and increase the travel of the valve to full port opening? I have looked through old files, but find nothing that assists me in the case in hand. *A.*—The port opening depends not only on the piston area, but it also depends on the piston speed. The general practice is to make the steam port area equal to $\frac{1}{15}$ of the piston area for a speed of 600 feet per minute; for a slower speed, proportionally less, and for a higher speed proportionally greater. Now since your piston speed is just one-half of 600, it follows from the above that a steam port area of $\frac{1}{30}$ of the piston area is large enough. There will be no advantage in making it greater; in fact, it will be a detriment to do so, as this will increase the clearance, which for economy of steam in simple engines should always be kept as small as the smooth running of the engine will permit. There will be a back pressure in either case, but if the engine is well designed there should be practically no difference in the back pressure.

(302) "Subscriber," Norfolk, Va., writes: Please outline the best, simplest and most accurate way to temper steel springs made of flat steel, afterwards bent to a bow shape, and secured at one end by a bolt. We have much trouble with such springs; they either break or do not harden at all. *A.*—The best way will depend upon circumstances, mainly upon how many of these or similar springs there are to be tempered, and what facilities are available for doing the work. The first thing is to make sure that the steel is adapted to the purpose. Then, if the springs are forged, this forging should be properly done, and, if ground or finished, the grinding marks should run lengthwise of the spring and not crosswise. If there are but few springs, they may be heated in a clean forge fire—preferably of charcoal—and this heating should be done by a skilled blacksmith. They may be quenched in water, and then "blazed off" in fish oil, *i. e.*, fish oil may be put on them, and then held over the fire until the oil ignites and burns off. This may sometimes be repeated once to advantage, and cotton-seed oil may be used, or a mixture of the two oils. If many of the springs are to be made, they should be heated in a lead bath, quenched in water, and then put into oil in a covered iron vessel, which can be placed over the fire. A thermometer, introduced through a hole in the cover, and with its bulb immersed in the oil, should show a temperature of 600° to 650° F., depending upon the result of experiments to determine the best temperature for the steel used. The vessel may then be removed from the fire, and allowed to cool below the igniting point of oil before uncovering. Very satisfactory tempering may be done also in sand by placing the springs in clean sand in an iron vessel over a fire in such a way that they can be kept constantly agitated; draw them to a pale blue.

(303) C. J., Svenborg, Denmark, writes: I intend to build a gas motor, the gas for which (or rather vapor) should be furnished simply by a mixture of air and liquid best suited for the purpose and exploded in the cylinder when properly compressed. I am thinking of using electricity for igniting the charge. Now I would like to have your opinion as to the advisability of building an engine on this principle, and if advisable would like an answer to the following questions: 1. Which do you consider the best liquid for the purpose? *A.*—Kerosene oil or crude petroleum is frequently used with satisfactory results. 2. Will the change of temperature, within ordinary limits, of the surrounding air, have any effect on the nature of the explosive vapor? *A.*—No. 3. Will it require a powerful battery for firing the charge? *A.*—No. 4. I am going to use an old steam engine to experiment upon, which I think can be altered to suit my purpose with slight expense. The cylinder of this engine is $5\frac{3}{4}$ inches diameter and $\frac{9}{16}$ inch thick. Do you consider it strong enough? *A.*—The strength will limit the amount of work to be done, and if this limit is not exceeded the cylinder will be strong enough; but we do not see how you can use such a cylinder; it should be specially designed for the purpose, and it seems to us that when properly constructed there will be considerable difference between it and such as are used on ordinary steam engines. In our issues of September 10, 1887, and October 29, 1891, you will find illustrations and descriptions of stationary engines of this class which may aid you in designing the motor. We seriously doubt the practicability of constructing for land service a motor in which the gases are exploded in the cylinder, as for this a water-jacketed cylinder will be required with a constant circulation of water, which, of course, the motor has to carry, and which will limit its usefulness. This objection does not exist when the motor is to be used in a small steamboat, in which they are occasionally employed. Do not attempt to design and make one unless you are familiar with and experienced in this class of work.

(304) T. A., Harrisburg, Pa., writes: Kindly give me through your paper a formula for calculating the sustaining force of long white pine and other wooden columns say 40 feet long and about 12 inches square; also the best factors of safety. Please give all the information possible and explain method of calculation. *A.*—Mr. Charles Shaler Smith, C. E., of St. Louis, prepared the following formula for the breaking loads of either square or rectangular pillars or posts of moderately seasoned white and common yellow pine, with flat ends, firmly fixed and equally loaded, based upon experiments by himself. It is Gordon's formula adapted to those of woods, and gives results considerably smaller than Hodgkinson's. It is therefore safer.

$$L = \frac{5{,}000}{1 + \frac{0.004\ l^2}{b^2}},$$

in which L denotes the breaking load in pounds per square inch of cross-sectional area; l the length in inches; b the side of the square, or the breadth; that is, the least side of the rectangle. In words this formula reads: Square the length in inches; square the breadth in inches; divide the first square by the second one; multiply the quotient by .004; to the product add 1; divide 5,000 by the sum; the quotient will be the breaking load in pounds. To show the application of the formula we will take the following example: What will be the breaking load of a pillar of white pine 40 feet long and 12 inches square? Substituting for the symbols in the formula the values given in the example we have

$$L = \frac{5{,}000}{1 + \left(\frac{0.004 \times 480^2}{12^2}\right)} = \frac{5{,}000}{1 + \left(\frac{0.004 \times 230{,}400}{144}\right)} = 675.67$$

pounds per square inch of cross-sectional area, and $675.67 \times 144 = 97{,}296.48$ pounds for the breaking load; or 48.6 tons. The strengths of wooden pillars depend much on their degree of seasoning. Hodgkinson found that perfectly seasoned blocks two diameters long required in many cases twice as great a load to crush them as when only moderately dry. This should be borne in mind when building with green timber. In important practice timber should not be trusted with more than $\frac{1}{8}$ to $\frac{1}{6}$ of its calculated crushing load, and for temporary purposes not more than $\frac{1}{4}$ to $\frac{1}{3}$. For the breaking load on columns computed from the foregoing formula see Trautwine's Engineers' Pocket-book.

(305) R. E. H., Albion, Mich., writes: Kindly inform me how to find the radius of gyration of a pulley or a fly-wheel. *A.*—For all practical purposes it is near enough to take for the radius of gyration the distance from the center of pulley or fly-wheel to the center of gravity of the cross-section of the rim. 2. I would like to have the modulus of elasticity and the ultimate strength of the following materials: Wrought-iron, spring-steel, cast-steel, cast-iron, cast-brass and aluminum.

A.—MODULI OF ELASTICITY AND STRENGTH FOR EXTENSION.

	Modulus of Elasticity.	Ultimate Strength.
Cast-iron	15,000,000	20,000
Wrought-iron bars	25,000,000	55,000
German steel tempered and annealed	29,000,000	116,500
Steel	30,000,000	100,000
Brass	9,100,000	17,700

MODULI OF ELASTICITY AND STRENGTH FOR COMPRESSION.

	Modulus of Elasticity.	Ultimate Strength.
Cast-iron	15,000,000	90,000
Wrought-iron	25,000,000	55,000
Steel	30,000,000	150,000
Brass	....	10,400

All these numbers express values in pounds referred to a cross-section of one square inch. These values will vary with the quality of the material, and in some cases it may be considerable. For the strength of aluminum see our issue of February 5, page 3, 1891. 3. What part of the ultimate strength is it safe to rely on in each, or what is the factor of safety? *A.*—The factor of safety depends much on the importance of the structure. The following are the average values of the allowable factors of safety employed in American practice:

Material.	For Steady Stress (Buildings)	For Varying Stress (Bridges).	For Shocks (Machines)
Timber	8	10	15
Brick & Stone	15	25	30
Cast-iron	6	10	15
Wrought-iron	4	6	10
Steel	5	7	10

These values are subject to considerable variation in particular instances, not only on account of the different qualities and grades of the material, but also on account of the varying judgment of designers. They will also vary with range of varying stress, so that different parts of a bridge may have very different factors of safety. The proper allowable working strength of any material for tension, compression or shearing, may be at once found by dividing the ultimate strength by the proper factor of safety. Regard should also be paid to the elastic limit in selecting the working strength, particularly for materials whose elastic strength is well defined. For wrought-iron and steel the working strength should be well within the elastic limit. For cast iron, stone, brick and timber it is often difficult to determine the elastic limit, and experience alone can guide the proper selection of the working strength. The above factors of safety indicate indeed the conclusions of experiment and experience extending over the last hundred years. These remarks and factors of safety are from "Text-book on the Mechanics of Materials and of Beams, Columns and Shafts," by Prof. Mansfield Merriman.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gear Wheels, Gear Cutting, page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters. Best in the market. Superior Machine Works, 106 Canal St., Cleve'd, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves, T. Kieley, 11 W. 13th St., N. Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

We have special facilities for the cheap manufacture of medium weight machinery; write us for prices. Kollmyer & Talbot, Keokuk, Ia.

25" / 32" / 37" / 42" — "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Just Pub.—Safety Valves, History, Invention & Calculation. By W. B. LeVan. Fully ill. $2. Cat. of Machinists', Electricians' & Engineers' books sent free. N. W. Henley & Co., 150 Nassau St., N. Y.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Quarter Turn Belts.

BY H. C. HECKENDORN.

I notice in your issue of June 2d, Query No. 241, that R. S. R., of Baldwin, La., asks for information how to line a pulley that is at right angles with another (quarter turn).

Answering him, you show a diagram, and also state thus: "The single and sufficient condition that the belt may run properly under these conditions is this: The point at which the belt is delivered from each pulley must be in the middle plane of the other pulley."

All of the scientific literature upon this problem that has come to my notice is identical as respects diagrams and rules with that given by yourselves.

I am well prepared to state that these rules and diagrams are entirely incorrect—quarter turn belts do not *want* to run as you

show, although they may be *compelled* to run thus by giving sufficient crown to the pulley faces.

With straight-face pulleys the belt would *rarely* run satisfactorily thus, unless the center distances of the shafts are great, or the belt very narrow as respects diameters of pulleys.

As respects the influence of flat belts away from their normal course, I have in mind a case where I at one time made a miscalculation in designing that was irreparable in a proper way, and I resorted to the unique trick of crowning the pulley on half of its face, and retaining the other half straight; in this way I caused the belt to run considerably out of its natural path, and it worked beautifully, and got me out of a rather uncomfortable scrape *unnoticed*.

I herewith send you a blue-print diagram of a quarter turn belt which I have specially prepared for you. The data contained thereon is from machines which I designed twenty years ago—gang drilling machines, with automatic feeds for hardware manufacture. There have been made since that time many hundreds of these.

You will notice that I take advantage of the side creeping tendency of the quarter turn belt to effect a return motion of the spindle after the feed cam has passed its maximum radius. This side-creeping action I have quite frequently used on "vertical" spindles of the same character as shown in the drawing, and it is surprising to observe the satisfactory manner of their climbing within the belt, and entirely dispensing with the necessity for either springs or counterweights for supporting the weight of these vertical spindles. The drawing sent herewith shows a "horizontal" spindle.

You will notice in my diagram that the belt leads very much outside of the "middle plane" of the leading on pulley; in fact, the entire width of the belt at this point is *outside* of a parallel to a perpendicular intersecting the two shafts, and if both pulleys have straight faces this will *always* be so, and *more so* if belts are wide or center distances close.

Some nine years ago I happened to go into a factory where they were putting up some new shafting and making some changes, and I noticed the putting up of a "quarter turn" belt, and the placing of the pulleys therefor. The pulleys were about 30" diameter, belt 10" wide, and center distances of the shafts 14 feet. A plumb line was hanging from the radius distance of the upper pulley to the mid-face of the lower pulley. The off-side of this lower pulley was almost against a stone foundation wall. I told the men in charge of the job that the belt would not run satisfactorily with the pulleys so adjusted. The *thanks* which I received were to the effect that they understood their business, etc. I drew the proprietor's attention to the matter, and he replied that these men were experts at the business, and thought that they should understand the problem, but as it had been given to them by contract, they would be required to make it operate satisfactorily, or not get their pay.

I called next day to see the thing start up (?) but only got there in time to see the men removing the stone wall, so as to give room for moving the pulley about 6" *further* out of line. After these changes (which were in accord with my suggestions of the previous day) the belt took its course in the middle of the pulley faces. I made no comments, nor did they; they observed, however, that I was "on deck," and likely their frame of mind was different from mine just then.

If your inquirer, Mr. R. S. R., will take some hints from this article and adjust his pulleys accordingly, I hope he will record his results in the AMERICAN MACHINIST for the benefit of others who have had their belts and *ideas* guided out of line.

A bill has been formally reported on by the committee in charge in Congress, making it unlawful for any common carrier to insert in any bill of lading or shipping document any clause whereby the carrier shall be relieved from responsibility for loss or damage arising from negligence or failure in proper loading of merchandise committed to their charge, nor shall it be lawful to limit its liability for less than the full value of any article lost or damaged.

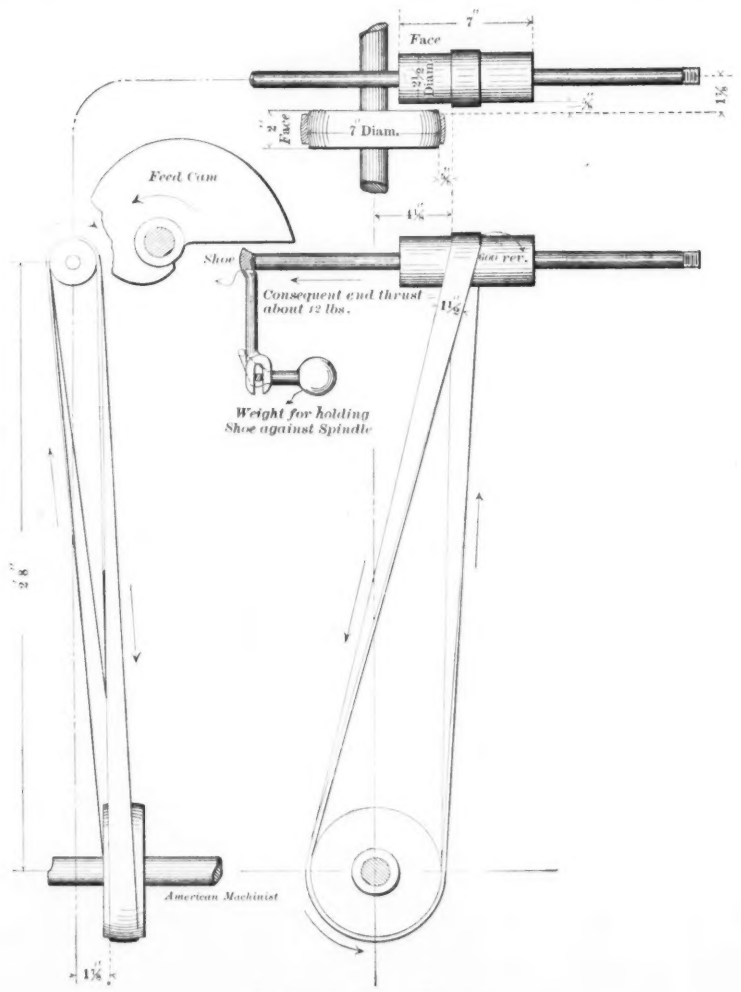
Harmless Trolley Wires.

BY JOHN H. COOPER.

In answer to the question how a trolley wire may be so conditioned as to serve its intended purpose and do no harm to man, beast or property, the following is offered:

First—To rob the wire of danger in case of contact after breakage.

This may be effectually done by an automatic cut-off governor, which will instantaneously sever the two wires from dynamo connections in the station house at the very moment of breakage of the wire, whenever and wherever such break may occur. By the same movement of the governor the surcharge of the wires, if any, will be grounded. The effect of this arrangement will be the instantaneous discharge of all electricity from the trolley wires at the moment of breakage, so that the ends of the wires fall to the ground as dead wires, not capable of doing any injury whatever.



QUARTER TURN BELTS.

The writer does not see any more difficulty in doing this effectually than in stopping a steam engine at once when the governor belt breaks or slips off, which latter is done by a very simple contrivance, and with unfailing result.

Second—Place the wire out of harm's way.

The best and safest place for a trolley wire, in the opinion of the writer, is in a conduit beneath the roadway; not in a central position between the rails, after the manner of the cable, which is inconvenient of access, makes *three* lines of rails on the street where *two* will do, and will cost more than necessary—but at the side just outside of one rail.

The Buda Pesth system which has been offered has two lines of rails, but they are of novel construction, require too wide a slot for our narrow tires, demand too frail a flange on the car wheels when the slot is reduced in width, and permits too much wear and tear upon itself and upon the paving which joins the slot track. The present form of rail prevents all this by supporting and guiding the traffic upon its own flat surface.

The writer hereby suggests that the present roadways, the existing forms of rails, wheels and other appertaining mechanism, and all parts thus far found serviceable and necessary to the simplest working of a horse railway, shall be maintained and used as they now are, unaltered.

The slot should be formed just outside of one rail, the existing rail making one side of it, the other side of the slot to be formed of one edge of the conduit through which the trolley wire is carried beneath the rail, and the width of the slot to be the least that will permit a conductor and holder of same to pass.

That part of the interior of the conduit near to the wire to be mineralized by any of the well-known methods, so as to insulate the same and reduce loss of electricity.

This arrangement permits examination and repair, by removal of cover outside of slot without interfering with the run of the cars or of the roadway for the ordinary traffic.

This type of electric roadway is most favorable to street repair, and reduces the amount of it. It will permit of single or double track runs, or switching off or on to the main line, as any other type of subway line. This plan has merit, because it uses the well-known and well tried surface way, and simply locates the trolley wire beneath the surface of the ground, where it can do no harm whatever, and where it is equally as accessible for repair or renewal as when suspended in the air on costly supports, in the midst of entanglements with other existing wires, where it is ever liable to all sorts of damage, and ready at any moment to the doing of great injury to life and property.

It promises well because we have the best proof of successful performance in the foreign type of underground wire in similar climate to ours, and there is no apparent reason why the details may not be worked out by the ordinary best mechanical methods as any other.

Economy the Road to Wealth.

"Whose fine mansion is that?"

"That is the dwelling of old Bigginsby, the coal baron. It represents an entire year's pinching, scraping, and economizing."

"He's immensely wealthy, isn't he?"

"Worth millions."

"Then what was the need of his pinching and scraping?"

"Oh, he didn't have to do the economizing. He made a 10 per cent. cut in wages the year he built it."—*Chicago Tribune.*

MANUFACTURES

The Plymouth (Mass.) Foundry will enlarge its plant.

More machinery will be put in the Eufaula (Ala.) Cotton-mills.

The Newnan (Ga.) Cotton-mills will put in additional machinery.

The Pioneer Worsted Co., Louisville, Ky., will put in more machinery.

Charles Raymond is enlarging his sewing machine factory at Guelph, Ont.

The Thompson Boiler Co. has been incorporated in Chicago, Ill. Capital, $500,000.

The Coosa Manufacturing Co., Piedmont, Ala., will put in additional machinery.

The manufacture of road-constructing machinery will be established at Hoosick Falls, N. Y.

The New York Central Iron Works, Geneva, N. Y., has added a new boiler shop, 70x70 feet.

The Worcester & Millbury (Mass.) Electric Railroad Company will have a new power plant.

An addition will be built to the Washburn shops of the Technology Institute, at Worcester, Mass.

The American Automatic Manufacturing Co. has been organized in Chicago, Ill.; capital, $500,000.

Wooley & Kenyon, of Anderson, Ind., intend to erect a large brass foundry beside their iron foundry.

Dobie & Stewart, of Thorold, Ont., will erect an iron foundry and machine shop at Niagara Falls, N. Y.

The Denver Hardware Manufacturing Company has begun the erection of a new foundry at Denver, Col.

The Boston Street Sweeping Machine Company is a newly incorporated $500,000 concern, at Portland, Me.

The United States Windmill and Power Co. has been organized at Batavia, Ill., with capital of $100,000.

A bridge will be built over Goose Creek, Evergreen Mills, Va. The commissioners will advertise for bids.

The Hanover Foundry and Machine Company is building a new blacksmith shop at its plant at East Hanover, Pa.

The erection of a large plant is talked of for New Castle, Pa., to manufacture springs and continuous mills.

The F. P. Gravely Machine Company has been incorporated in New Orleans, La., with capital stock of $10,000.

The Pierce & Miller Engineering Co. has been organized in New York City, to manufacture tools; capital, $1,000,000.

The recently burned Fulton Iron Works, at San Francisco, Cal., will probably be rebuilt in Oakland.

The Fales Foundry, Troy, N. Y., which had been closed for some time, has started again in full, employing nearly 100 men.

Elwood Beadle is endeavoring to organize a company at Centre Star, Ala., to manufacture his patent cotton baling press.

Wais & Roos Punch and Shear Company is a new incorporated concern in Cincinnati, O.; capital stock, $30,000; paid in, $25,000.

C. W. Jacobs, C. J. Hicks, C. G. Butt and A. H. Carey have chartered the Southern Irrigation Co., at Orlando, Fla., with a capital stock of $25,000.

Mark Golinsky will erect a marine railway on Buzzard's Roost Island, opposite Brunswick, Ga. It is proposed to build one with a capacity of 1,000 tons.

A $100,000 stock company will be organized to erect a thread mill at Savannah, Ga. The Southover Land and Improvement Co. can supply information.

W. G. Nunn, D. N. Myrick, J. W. Nail and others have incorporated the Ladonia (Texas) Cotton Oil Co., with a capital stock of $30,000, to manufacture cotton-seed oil.

The National Engineers' Supply Company has been incorporated at Chicago, with a capital of $100,000. Incorporators, John Stirling, Wm. Irven and M. Kavanaugh.

Work has commenced at Carlisle, Pa., on the new frog and switch works. The shops will be 30x100 feet, and will be so planned that the capacity can be doubled at any time.

The Standard Manufacturing Co. are building a new shop in Hartford, Conn. The building is 137x40 feet, with an L 50x35 feet. The new plant is expected to be ready by August 1.

The Sprenkle Pulley Co., Pennsboro, W. Va., manufacturer of pulleys, has obtained charter. The incorporators are M. K. Sprenkle, T. D. Morrow, J. K. B. Waddle and others; capital stock, $75,000.

The Iron Works Corporation of Fall River, Mass., intends to build another mill. It is said that the contractor has received orders to begin work on the site for a third factory as soon as the present one is completed.

Messrs. John Chamblen, Alex. Delaney and Jas. H. Hall will succeed Jos. Hall & Co. as proprietors of the Richmond (Va.) Iron Works. A new build

ing will be added to the plant, and operations will be actively continued.

The Newark Machine Tool Works, Newark, N. J., issue a circular describing the horizontal boring and drilling machines made at the works. They make a specialty of such machinery.

The new Yale Steel Company, of New Haven, Conn., is to occupy the New Haven Nut Company's old building at Westville, and preparations are to be immediately made thereat to manufacture polished steel rods for twist drills, dental tools, watch and clock parts, needles, etc., on an extensive scale

There is water-works agitation in Oshkosh, Wis.; Spokane, Wash; Wheeling, W. Va.; Lowville, N. Y.; Waterloo, N. Y.; Athens, Ga.; Key West, Fla; Davenport, Iowa; McKeesport, Pa.; El Paso, Tex.; Jacksonville, Fla; Kent, Wash.; Malvern, Pa.; Chapel Hill, N. C.; Jamestown, N. Y.

The Builders' Iron Foundry of Providence, R. I., is now finishing and assembling for the U. S Government, for coast defense, forty-three twelve-inch breech-loading rifled mortars, making, with those finished under a previous contract, seventy-three guns of this type from the works of this company.

The National Pipe-bending Company, New Haven, Conn., manufacturers of coils and bends of iron, brass and copper pipe, and of the National feed-water heater, report a very good summer's trade, having sold seventy-two heaters in the last two months, aggregating over 15,000 horse-power. Their coils and bends are made of all styles and izes.

The Brown & Sharpe Mfg, Co., Providence, R. I., issue the following: Our works will be closed from August 1 to 13, inclusive, for annual vacation and repairs. Please bear this in mind in connection with any orders you have in contemplation. The office will be kept open as usual, and all orders will be promptly filled for machinery or tools described in our catalogue and usually kept in stock.

The Herendeen Mfg. Co., Geneva N. Y., issue a circular of their heating boiler, which is made in all sizes and for all purposes of heating by steam or hot water; also another catalogue relating to "House Warming and Ventilation." These catalogues will be found of interest to engineers and to general readers. Boilers made by this company are to be used for heating the greenhouses attached to the horticultural buildings of the World's Fair.

Mr. Rogers, general manager of the Morewood Tin-plate Works, the largest tin-plate concern in Wales, or in the world, on the occasion of his recent visit to this country, purchased ten acres of land at Gas City, Ind., and has arranged to establish extensive tin-plate works there, additional to the works previously in course of construction and equipment at Elizabethport, N. J. It is intended to locate the rolling-mills at Gas City, which are to supply both establishments.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for the new tin-plate works which Hughes & Patterson are to erect at Philadelphia, Pa. The buildings will be of iron from the designs of the Berlin Co. The main building will be 40 feet wide by 253 feet long, with a wing of the same width 300 feet long, both two stories high. The rolling-mill will be 120 feet wide by 160 feet long, with an annealing room 75 feet wide by 160 feet long. The whole plant will require about 800 tons of iron to be used in its construction.

The Diamond Clamp and Flask Co., of Richmond, Ind., have published a table which tells at a glance the amount of a molder's wages when working by the piece, the prices paid for putting up the flasks advancing by fractions of a cent from 2 cents to 12 cents, and the number of flasks from 2 to 200. The border surrounding this table is an engraving of the Diamond snap flask, and the whole thing forms an attractive, and, of course, very useful thing to hang upon the walls of a foundry or in the foreman's office, as it saves much time spent in figuring up wages, and prevents mistakes. The table is sent mounted on card-board for 50 cents, or free with an order for wedges or flasks.

Machinists' Supplies and Iron.

NEW YORK, July 16, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14 50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $14.25 to $15 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is steady.

We quote Hallett's, 10¾c. to 11c; Cookson's, 14c. to 14½c.; and L. X., 12½c. to 12⅝c.

Lake Copper—Lower prices rule the market. Large sales are reported at 11.20c. to 11.30c. There are additional offerings at 11 30c with 11.25c. bid Casting Copper is held at 10¾c to 11¼c.

Lead—The market is weak and buyers are scarce. Car load lots are quoted at 4.20c. and probably 4.15c. would buy.

Lard Oil—The market is quoted at 61c. for Prime City. Western on spot is quoted at 60c.

Spelter—Some business has been done on the spot at 4.80c., and this price is named for shipments. It is claimed that 4 75c. would buy.

Tin—The market is declining. Large holders of stock are free sellers, and the principal buyers seem to be consumers. Spot is quoted at 20.60c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Sit. by exp mach. shop foreman on eng. & gen. mach'y; understand ind'r, J. A., AM. MACH.

Wanted—Position as foreman boiler maker; reference furnished. Foreman, AMERICAN MACHINIST.

Wanted—Position, by a first-class mechanical draftsman, exp'd in air compressors, stationary and marine engines. Box 27, AM. MACHINIST.

Wanted—Foreman for foundry employing 20 men, making steam pumps and light castings. Address Foundry Foreman, care AM. MACHINIST.

Educated eng., excellent address, widely known, energetic, desires selling pos'n, exp., conveyors, tool, transmission & gen. mach'y. Practical, AM. MACH.

Pattern Maker—Young man about 25 on ribbon weaving loom work; one who can make drawings; good opportunity for advancement. Address, stating experience, and wages exp., W. H. S., AM MACH.

Wanted—Situation as superintendent or foreman of foundry; 15 years' experience on marine and heavy castings of every description; best of references given. Address Box 25, AM. MACHINIST.

Mechanical engineer, with shop and drafting room experience, wants situation as designer, draftsman or foreman; in a small machine shop preferred; references. Address G. G., AM. MACH.

Wanted—First-class man, who has had long experience in Corliss engine building; must be first-class draftsman and inspector, and able to figure on compound condensing plants. Address, giving exp., ref., and salary desired, Box 28, AM. MACH.

Traveling salesman wanted to represent a firm building high-speed automatic engines; a mechanical engineer preferred; one familiar with steam engineering. Address, stating previous experience and salary expected, Business, care AM. MACH.

A mech. eng. desires a position of responsibility in a manuf'y; exper'd in every detail in mod meth. on interchangeable work, devis'g labor saving tools and adapting mach'y to produce econom'l results; excellent designer & draftsman. Box 32, AM. MACH.

Wanted—Two young men of some education and exp. as draftsmen in a heating and ventilating department; position offers plenty of opportunity for advancement; must be quick and accurate at figures. Address, stating age, experience, with ref., & salary wanted, Buffalo Forge Co., Buffalo, N. Y.

Wanted—In a western city a young man, draftsman, on machine tool work; must be accurate and willing to make himself useful in general drawing room work; give full particulars as to experience, salary wanted, and reference. Address X. Y. Z., AMERICAN MACHINIST.

Wanted—Foreman for our machine shop; power, transmission and gen. machinery. None but competent men need apply. A. B., AMERICAN MACHINIST.

Wanted—At Sibley College, Cornell University, Ithaca, N. Y., several good workmen as instructors in the various shops; should be about 30, studious, skillful, interested in their work, and appreciative of the opportunities offered in residence at a great university; pay moderate, but positions otherwise attractive to the right men. Address the Director.

Wanted—A first-class experienced jig and special tool maker; one thoroughly acquainted with Corliss engine work, who has had experience in getting up jigs, and special devices for insuring uniformity and accuracy in the work, and reducing the cost; a good job for a strictly first-class man; none other need apply. Send references, age, and experience in the work, with wages expected, Sioux City Engine Works, Sioux City, Ia.

Wanted—Superintendent for one of the largest, most progressive and best known machine tool concerns in the United States; will have entire charge of works; none need apply except those now in similar position with one of the standard tool builders of the country; must be progressive, and in touch with the most modern shop practice. For the right man this is the opportunity of his life; much more back of it than can appear in an advertisement; all communications strictly confidential. Box 31, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wall Drills complete, $25. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

For Sliding Gauges, E. G. Smith, Columbia, Pa.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Stolpe's Universal Punch is new and the best; write for circular. Stolpe, 154 W. 27th St., N. Y.

Design & superintendence of mach'y. Drawings, etc., made. Claud Mantle, 598 E. 134th St., N. Y.

George D. Slade, dealer in molding sand of all grades, Waterford, N. Y.

For Sale, Cheap—Patent of grip pipe wrench. Address B. F. Chappell, Quarryville, Conn.

BRADLEY HAMMERS

2000 IN USE.

FOR 20 YEARS these Hammers have been in the market and during all that time have been acknowledged the very best. The material we use and our method of construction are the result of ripe experience and not the jumped-at conclusions of amateurs. Send for circulars and price lists.

BRADLEY & COMPANY,
SYRACUSE, N. Y.

DYNAMOMETERS and the MEASUREMENT of POWER.
By Prof. J. J. FLATHER.
215 Pages, Illustrated, 12mo, Cloth, - - - - - - - - $2.00
JOHN WILEY & SONS, New York.

THE STANDARD REVOLUTIONS COUNTER.
PROVIDENCE, R. I.
A. B. Pitkin Mac'y. Co. Send for Circular.

PAT. STOP MOTION. Registers 2,000 Revolutions.

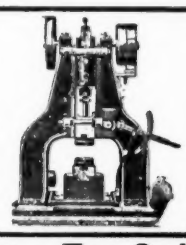
MACHINERY For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information address the Manufacturer,
S. W. GOODYEAR, Waterbury, Ct.

SOFT GRAY IRON CASTINGS.
From ⅛ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS
CANANDAIGUA, N. Y.

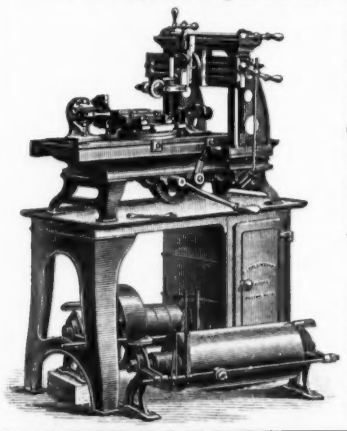
FRISBIE FRICTION PULLEYS AND CLUTCHES.
THE D. FRISBIE CO.,
114 LIBERTY STREET, - NEW YORK.

WHEN ORDERING NEW TOOLS INSIST UPON HAVING VANDERBEEK'S COUNTERSHAFT. SOME OF THE LARGEST SHOPS ARE TAKING THE OLD COUNTERSHAFTS OUT AND PUTTING OURS IN THEIR PLACES.
THE STATES MACHINE CO.,
HARTFORD, CONN.

PATENTS
TRADE-MARKS, CAVEATS, COPYRIGHTS.
Send model or sketch for free advice as to patentability. Full information in my fifty page book, FREE.
Address
SAML. C. FITZGERALD, Atty.,
1003 F Street, - - WASHINGTON, D. C.

HACKNEY HAMMERS
Meet all requirements more fully and satisfactorily than any other of its competitors.
INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.
WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.
20 Johnson St., CLEVELAND, O.


STEEL TUBES
WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

POWER OR HAND PLANER,
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.

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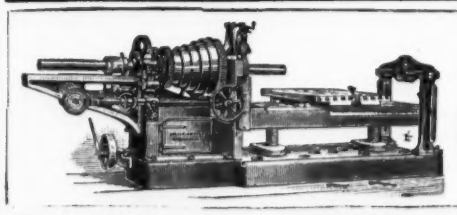
A. J. WILKINSON & CO.,
184 Washington Street, Boston, Mass.

Machine Shop For Sale.
$3000. Machinery almost new, rent low, power furnished; well equipped for general work; manufacture tools, special and experimental work. Bargain. Call or address, MACHINIST, 36 Penn St., Brooklyn, N. Y.

Experimental Work of every Description,
Mechanical and Electrical. Contractors for the manufacture of specialties, or can furnish complete plants for their manufacture. Make Dies, Special Tools, Gauges, Drawings, Patterns, Models. Inventions perfected. Estimates furnished. Correspondence solicited.
Send for Circular of our SENSITIVE KNEE DRILL.
BRADY M'F'G. CO. 83 Washington St., BROOKLYN, N. Y.

TO LET.
The Engine Works at Newburgh, N. Y., at present occupied by Wm. Wright, is offered to let from May 1st, 1892.
The Property consists of
MACHINE SHOP, FOUNDRY, BOILER, FORGE AND PATTERN SHOPS,
with a full equipment of tools.
The works are located in the heart of the city, and convenient to railroad and river transportation.
For terms, apply to
HOMER RAMSDELL,
NEWBURGH, N. Y.


BETTS MACHINE CO.,
WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
IMPROVED PATTERNS! LATE DESIGNS!

H. W. JOHNS'

ASBESTOS SECTIONAL PIPE COVERINGS.
Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. JERSEY CITY. CHICAGO. PHILADELPHIA. BOSTON. ATLANTA. LONDON.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Working drawings of mach'y furnished on short notice by practical draftsman. P. D. Q., AM. MACH.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Wanted—To sell the entire right of my universal bench vise; best testimonials from pattern makers and others. J. F. Emmert, Box 313, Waynesboro, Pa.

Wanted—A ten-foot boiler maker's roll; second hand, if good. American Hoist and Derrick Co., St. Paul, Minn.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 203 Broadway, New York.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Machine Tools in Stock.

ENGINE LATHES.

78 in. swing,	9 ft.	between centers		Sellers
38 do	17 ft.	bed, New		Fifield
30 do	14 do	do		do
27 do	16 do	do		Fifield
24 do	12 do	do		Fitchburg
24 do	12 do	do		Flather
22 do	10 do	New Pattern		Fifield
22 do	12 do	do		Blaisdell
22 do	12 do	New		Flather
22 do	8 do	do		do
21 do	10 do	do		do
20 do	8 do	do		do
20 do	10 do	do		do
18 do	8 do	do		do
18 do	10 do	do		do
18 do	8 do	do		Blaisdell
18 do	10 do	do		do
16 do	6 do	do		Flather
16 do	6 do	do		Blaisdell
15 do	6 do	do		Flather
14 do	6 do	do		do
14 do	6 do	do		Blaisdell
12 do	6 do	do		do

PLANERS.

42 in. wide,	42 in.	high,	12 ft. long, 2 heads	Gleason
36 do	36 do		8 do	Pease
30 do	30 do		8 do	do
30 do	30 do		8 do	Whitcomb
30 do	30 do		8 do	Flather
26 do	26 do		6 do	do
24 do	24 do		6 do	do
24 do	24 do		6 do	Whitcomb
22 do	22 do		5 do	do
22 do	22 do		6 do	Flather

SHAPERS.

12, 16, 20 and 24 inch stroke	Eberhardt
15 and 24 inch stroke	Hendey

UPRIGHT DRILLS.

20, 21, 25, 28, 30 and 36 inch swing	Prentice
20, 23, 25, 28 and 34 inch swing	Blaisdell
60 inch swing Radial Drill	Baush

HILL, CLARKE & CO.,

156 OLIVER ST., BOSTON, MASS.
CHICAGO BRANCH, 12 and 14 South Canal Street.

NEW AND SECOND-HAND MACHINERY (In Stock.)

Engine Lathe, 66 in. x 24 ft., Heavy Pattern, for facing and boring.	Low price.
" " 60 in. x 20 ft., Heavy Pattern.	" "
" " 20 in. x 10 ft., Ames, C'p'd Rest and Cross Feed, special reverse feature, complete.	A1 order.
" " 20 in. x 8 ft., Perkins, Hollow Spindle and Cross Feed, complete.	A1 order.
" " 24 in. x 12 ft., Fitchburg, C'p'd Rest, Cross fd.	
" " 18 in. x 8 ft., C'p'd Rest, New Haven, complete.	
" " 16 in. x 6 ft., Lathe and Morse.	Good order.
" " 14 in. x 6 ft., Ashton, Hand.	" "
Planer, 17 in. x 4 ft., Whitcomb, modern style.	A1 order.
" 24 in. x 8 ft., Lathe & Morse, modern style.	" "
" 36 in. x 36 in. x 8 ft., Powell Planer Co.'s, latest pat.	A1.
" 48 in. x 10 ft., modern style.	Good order.
Gang Drill, 3 spindle Pratt & Whitney.	A1 order.
Upright Drill, 24 in., Ames, complete.	" "
Radial " 5 ft. Arm, B'k G'd, Auto. Feed, Niles.	A1 order.
Shaper, 9 in., Crank Motion, Hewes & Phillips.	Good order.
" 15 in., " " Gould & Eberhardt.	A1 order.
" 14 in., Trav. Head, Fitchburg.	" "
Slotting Machine, 9 in. stroke, modern, complete.	Good order.
Pipe Machine, 4 in., with full set Dies. Morris & Tasker's.	
Screw Machines, 15-16, 1 3-8 and 2 1-8 in. holes, Brown & Sharpe and Jones & Lamson makes, with Tools.	Good order.
Hand Miller, Garvin—latest.	Good as new.
Profiling Machine, 2 spindle. Pratt & Whitney.	Good.

IMPROVED NEW TOOLS.

Engine Lathes, 14 to 48 in. Swing. Fitchburg, Hendey, Ames and Perkins makes. Double and Triple Gear.
Drills, 20 to 32 in. Prentice Bros. makers.
Planers, 24 to 42 in. Powell and Fitchburg makes.

BOILER AND BRIDGE TOOLS.

Riveting Machine, 60 in., for bridge and boiler work, modern style, with full hoisting outfit.	Good order.
Boiler Rolls, 6 ft., very powerful.	A1 order.
" " 8 and 10 ft., improved style.	New pattern.

J. J. McCABE,

SUCCESSOR TO
E. P. BULLARD'S
N.Y. Mach'y Warerooms.
68 Cortlandt Street,
NEW YORK.

SPECIAL INDUCEMENTS IN SECOND-HAND MACHINERY.

ENGINE LATHES.

1 18 in. x 8 ft. Worcester, Rod Feed, Plain Rest.	Good order.
1 16 in. x 6 ft. Hatfield, Rise and Fall Rest, H. S.	Good as new.
1 15 in. x 6 ft. Blaisdell, Rise and Fall Rest, Chuck and Tools.	A1 condition.
1 15 in. x 6 ft. Windsor Elevating Rest, 2 Chucks.	Good as new.

PLANERS.

1 22 in. x 22 in. x 5 ft. N. Y. S. E. Co.	A1 condition.
1 22 in. x 22 in. x 5 ft. Whitcomb.	Good as new.

DRILLS.

1 20 in. Wheel Feed, Quick Return.	Good order.
1 No. 2, 3-Spindle Garvin Elevating Table.	
1 No. 4, 6-Spindle Garvin " "	
1 4 Spindle Pratt & Whitney " "	

These Drills are in A1 Condition.

MISCELLANEOUS.

2 Jones & Lamson's Small Screw Machine, wire feed.	A1 condition.
1 Brown & Sharpe No. 2 Screw Machine, W. F.	Good as new.
1 Jones & Lamson No. 2 Turret Lathe	A1 condition.
2 No. 1 Garvin, W. F. Screw Machines,	Good as new.
1 Brown & Sharpe Plain Miller, No. 2.	" "
1 No. 2 Garvin " "	A1 condition.
1 Brown & Sharpe Surface Grinder.	" "

Power Presses, Screw Slotters and Tapping Machines.
Write for list of 400 new and second-hand machines ready for delivery.

THE GARVIN MACHINE COMPANY,
LAIGHT AND CANAL STS., NEW YORK.

Second Hand and New Machinery

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10 ft. x 10 ft. x 16 ft. Planer.	1 Head.			
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28 in. x 12, 14, 16, 18 ft. do	do	do	do	
21 in. x 10, 12 ft. do	do	do	do	
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18 in. x 6, 7 & 8 ft. do	New &	do	do	
17 in. x 8 ft. do	do	do	do	
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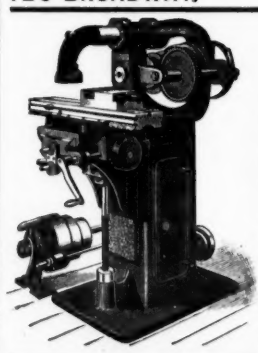

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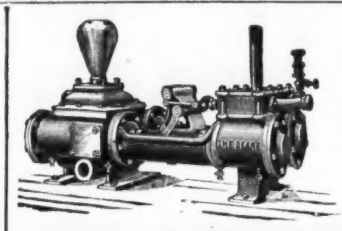

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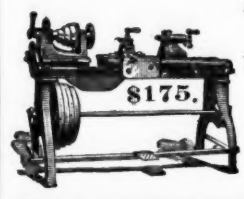

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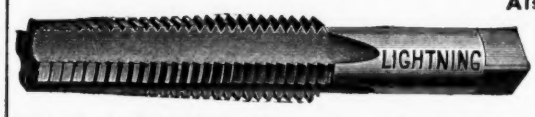

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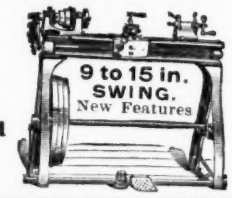

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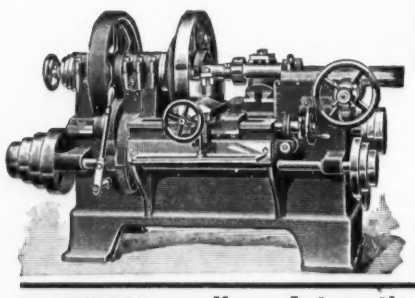

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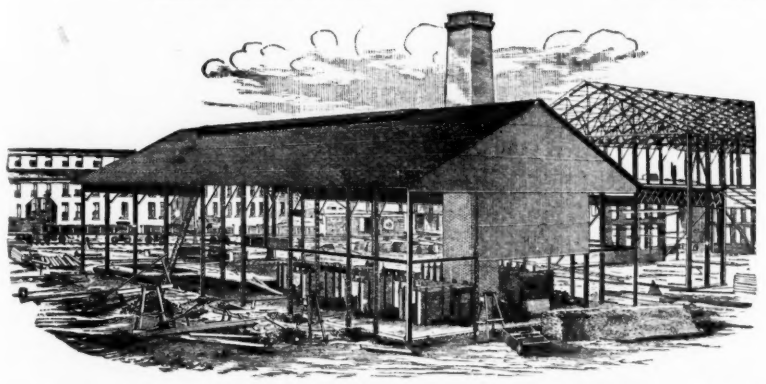

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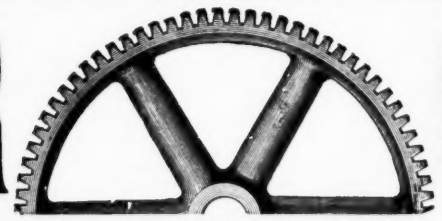

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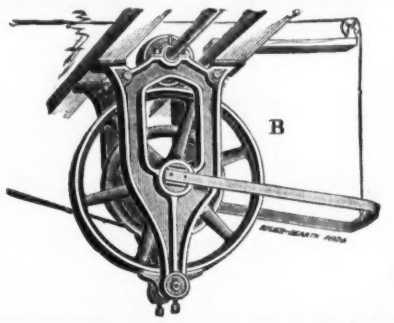

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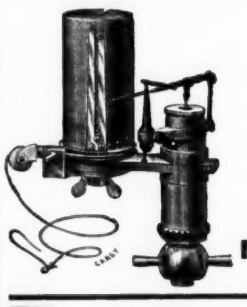

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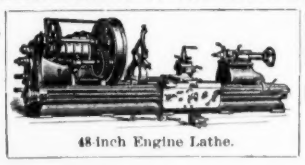
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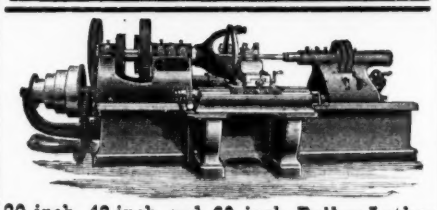

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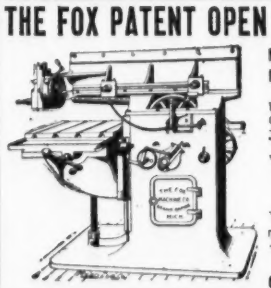

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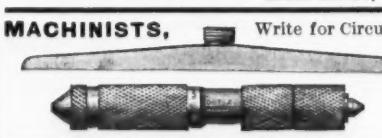

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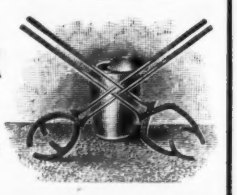

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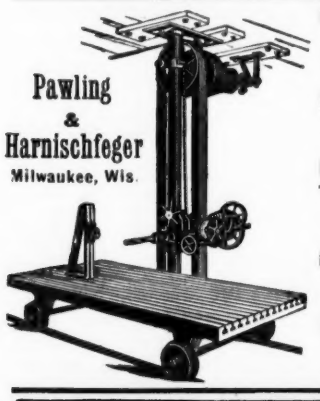

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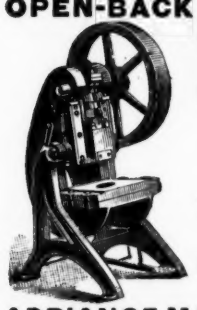

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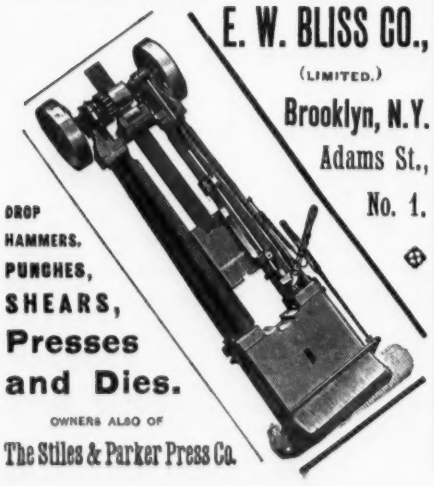

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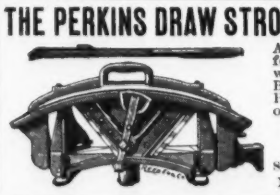

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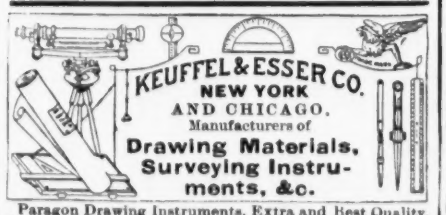

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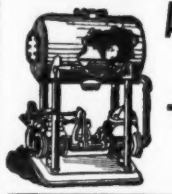

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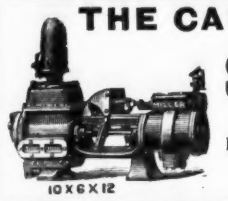

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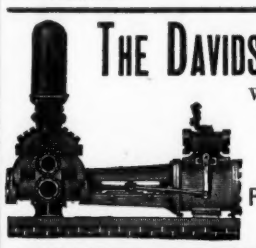

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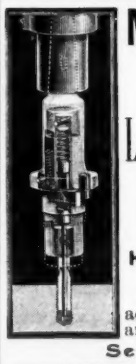

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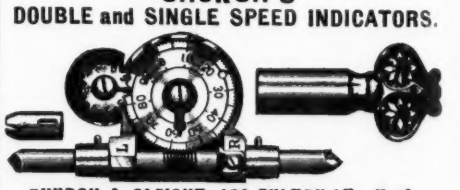

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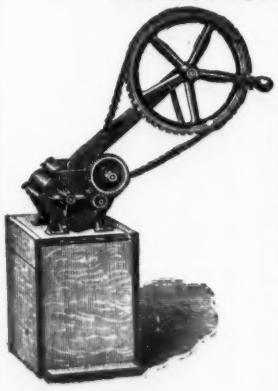

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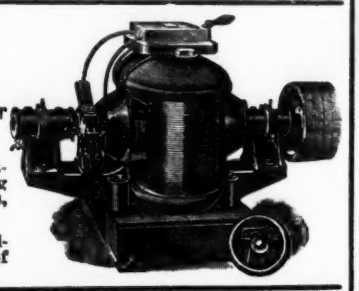

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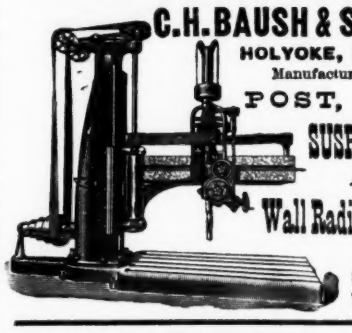

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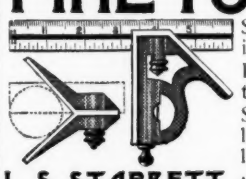

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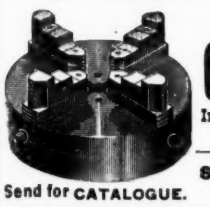

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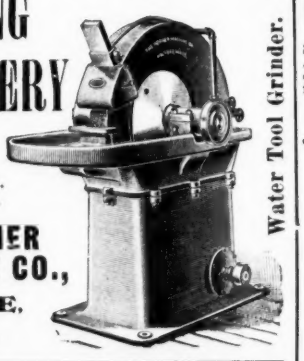

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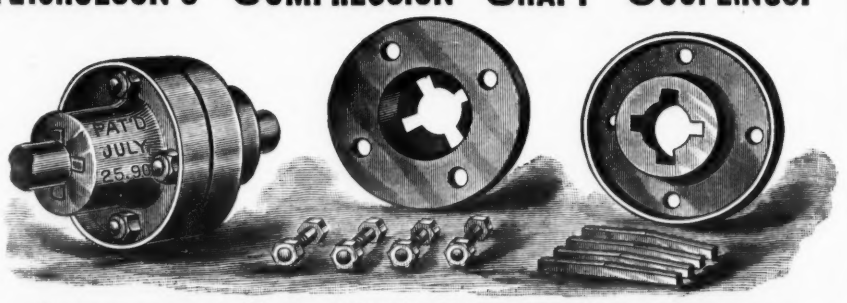

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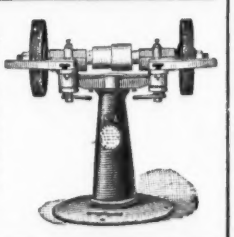

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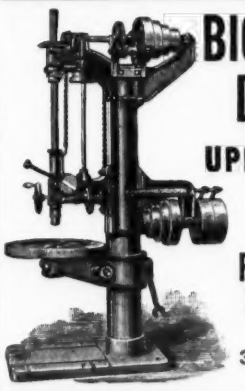

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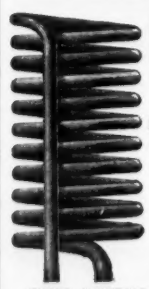

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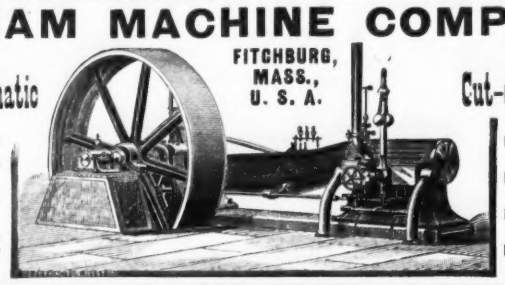

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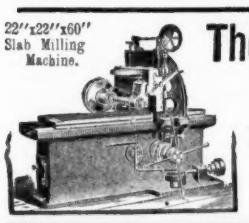

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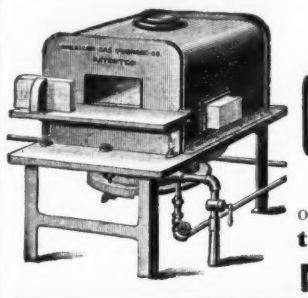

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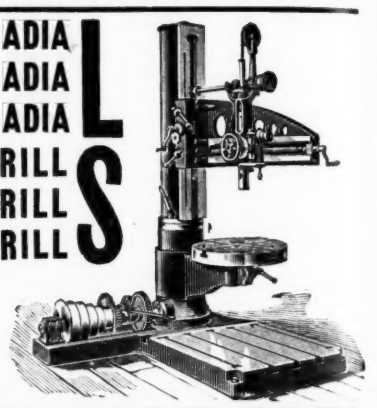

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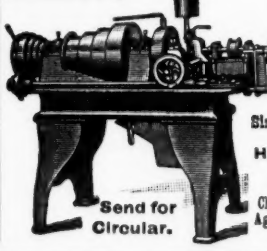

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A COMPLETE ENGINE LATHE AND COMPLETE TURRET LATHE IN ONE AT A REDUCED COST.

- Turrets are Interchangeable with Compound Rest or Tail Stock.
- Graduated Taper Attachment.
- Compound Rest.
- Automatic Stop.
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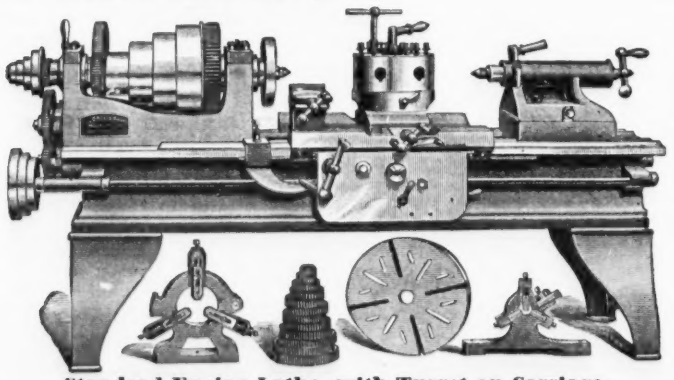
- Reverse in Apron.
- Lead Screw Inside of Bed.
- Quick Feeds.
- Powerful—Quick—Simple.
- Automatic or Plain Turrets.



Standard Engine Lathe, with Turret on Carriage.

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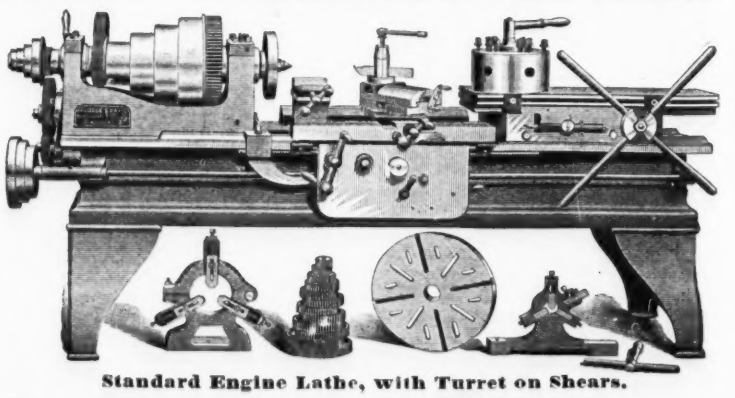
BOLT CUTTERS.



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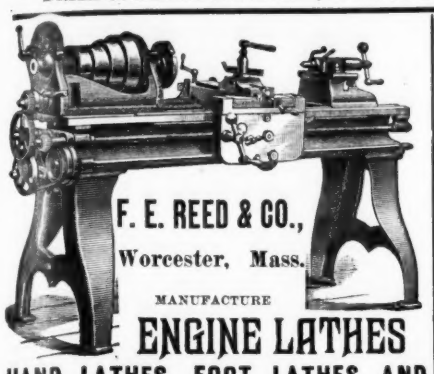
SEE ADVERTISEMENT, PAGE 20.

MORSE TWIST DRILL AND MACHINE COMPANY,
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



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HAND LATHES, FOOT LATHES AND MILLING MACHINES.
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SOMETHING NEW.
The Cincinnati Milling Machine Co.,
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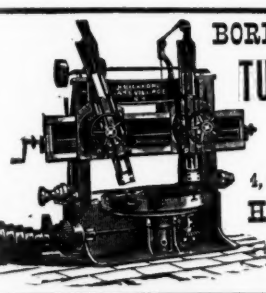

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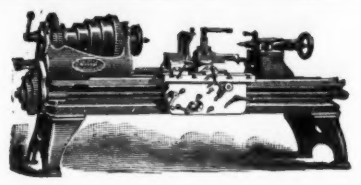

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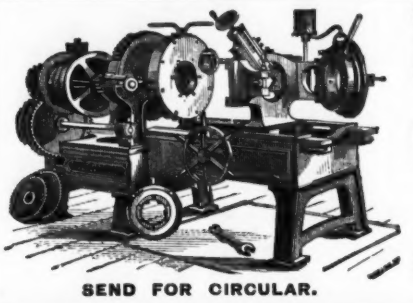

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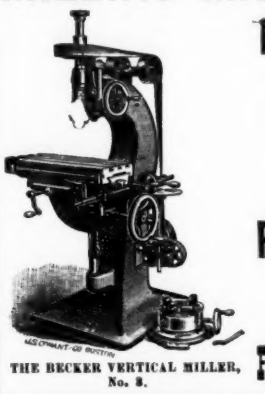

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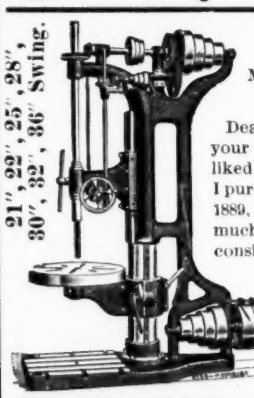

21", 22", 25", 28", 30", 32", 36" Swing.

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Very respectfully yours,
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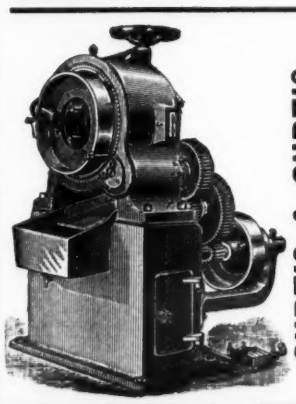

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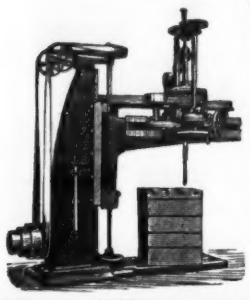

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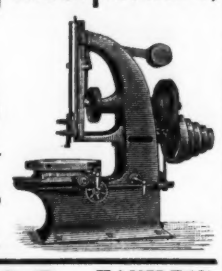

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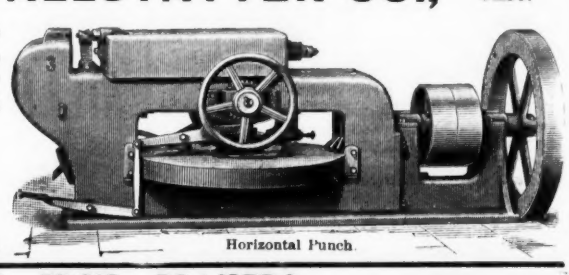
Horizontal Punch.

THE OPEN SIDE IRON PLANERS.
THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.
WEIMER MACHINE WORKS CO. Blowing Engines and Blast Furnace Machinery.
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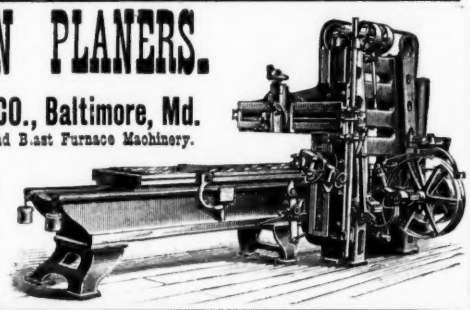
We have planed work on it that was 29 feet 6 inches long, and weighed 12 tons, without any difficulty.
We would not be without one of your planers.
WEIMER MACHINE WORKS CO.,
JOHN A. WEIMER, Superintendent.



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Also SEPARATE HEADS and DIES.
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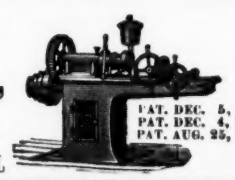
PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

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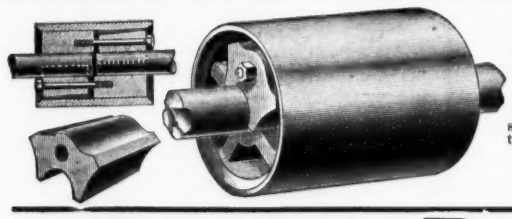

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SIMPLEST and BEST in MARKET.
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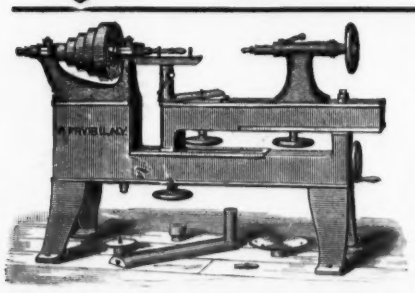
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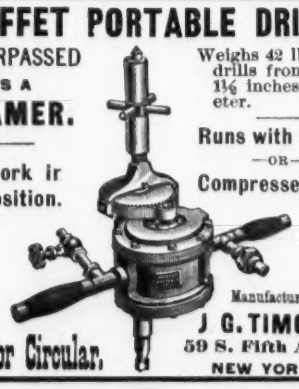

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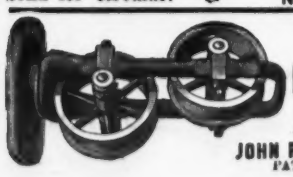

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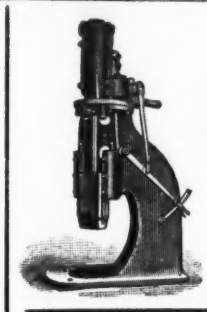

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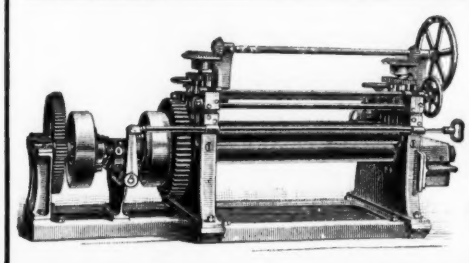

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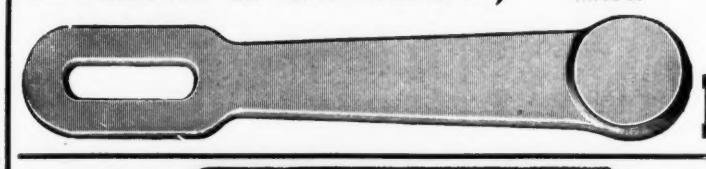

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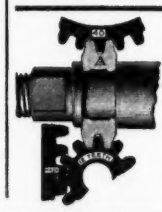
Manufacturers of Set, Cap & Machine Screws, Studs, etc.



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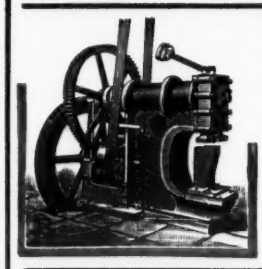

UNIVERSAL PUNCHING PRESSES
FOR
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ESPECIALLY ADAPTABLE FOR
STRUCTURAL IRON WORK.
HETHERINGTON & BERNER,
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THE ERIE KEY-SEATING MACHINE.
MANUFACTURED BY
THE BURTON MACHINE CO.,
302 Peach St.,
ERIE, PA.
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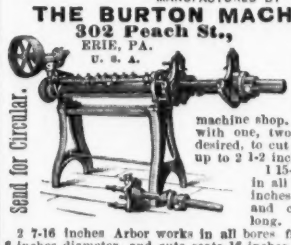
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With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.
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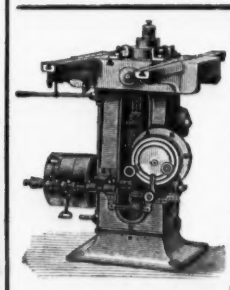
With recent patented improvements, we guarantee to do the following class of work.
To cut key-ways through 1¼-inch hole in hubs or sleeves 23 inches long, in iron, brass or steel, also make it dovetail to insert feather key.
Will cut through 4-foot hub, through 5-inch hole. Our new centering chuck and setting attachment the work can be set exactly, without the use of a scale or rule. Our new binding attachment takes the place of bolts, with a key-way and key to fit it.
For particulars address THE MORTON M'F'G CO., MUSKEGON HEIGHTS, MICH.



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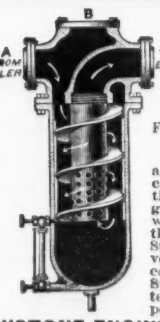

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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
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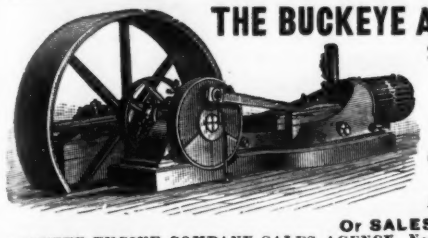

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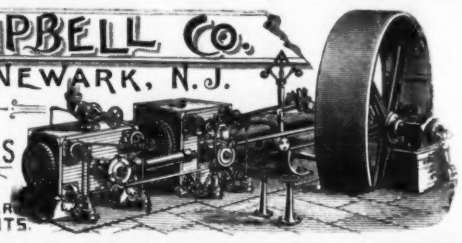

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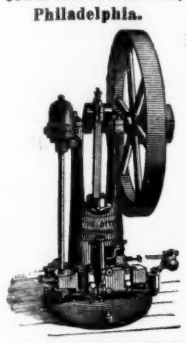

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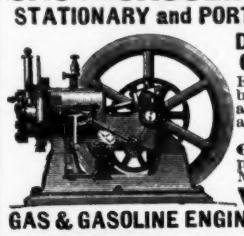

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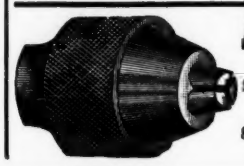

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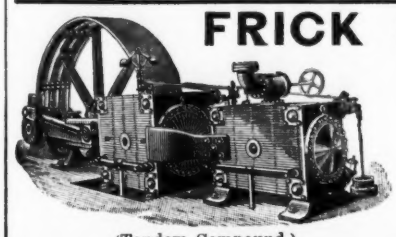

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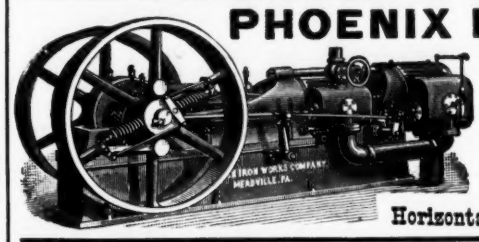

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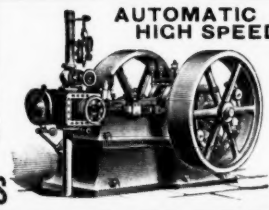

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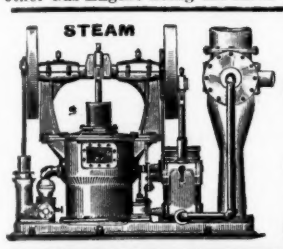

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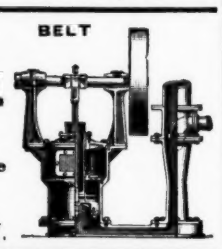

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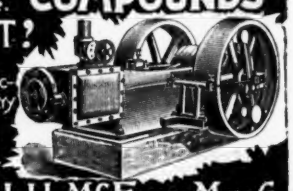

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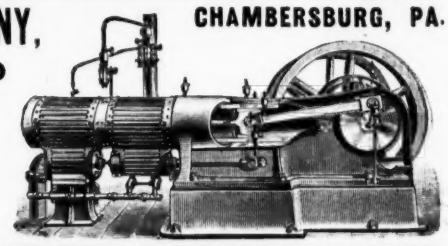

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Built in 17 Sizes, 1 to 90 H. P.

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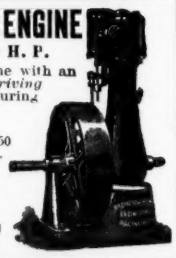

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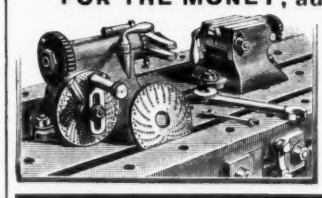

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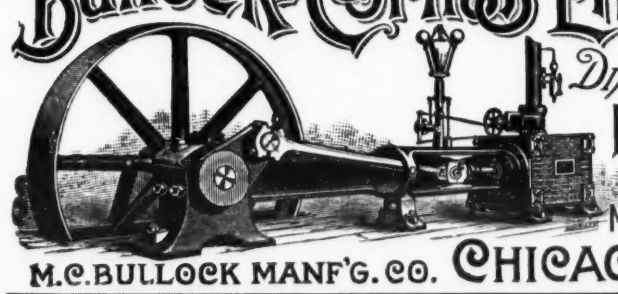

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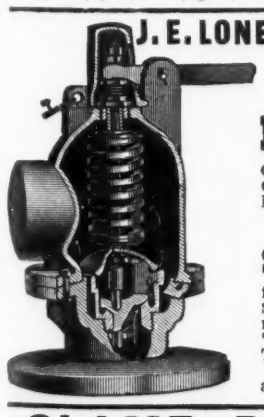

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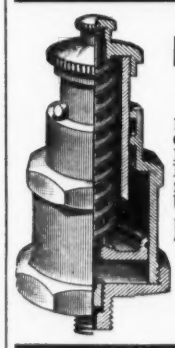

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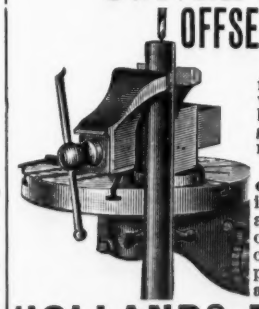

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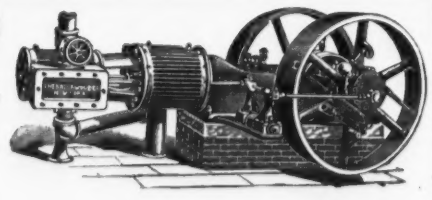

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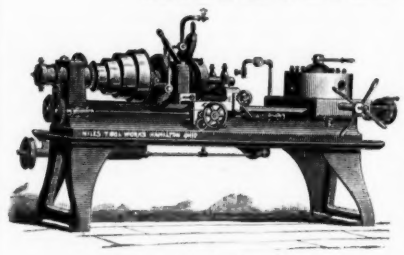

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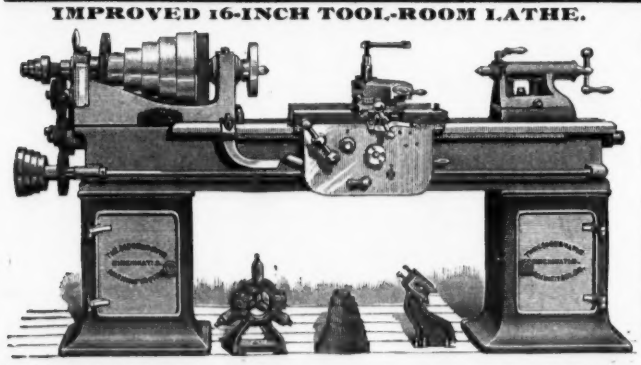

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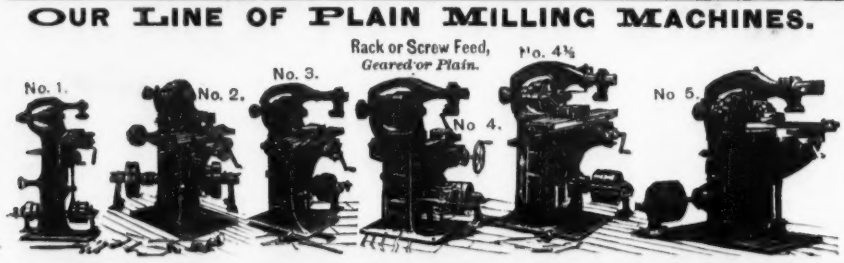

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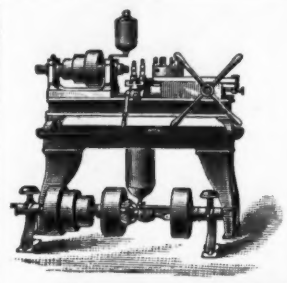

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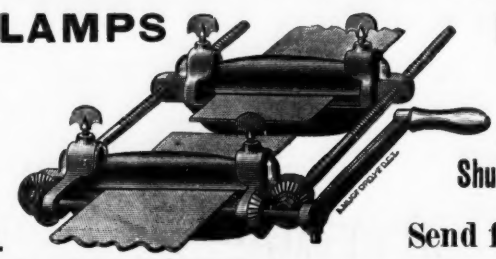

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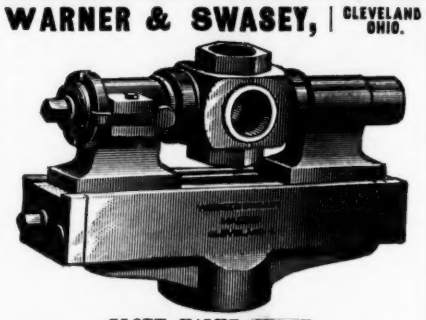

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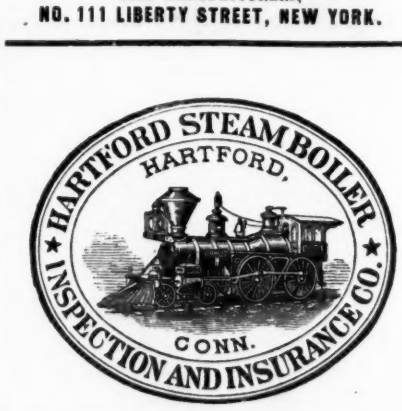

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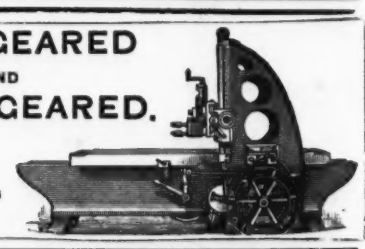

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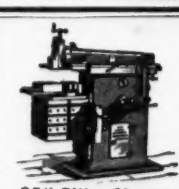

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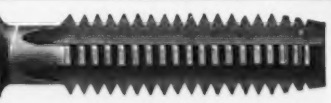

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